CEREAL SCIENCE today

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OCTOBER 1960 VOLUME 5 • NUMBER 8

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OF THE
AMERICAN ASSOCIATION
OF CEREAL CHEMISTS

OF INTEREST THIS MONTH

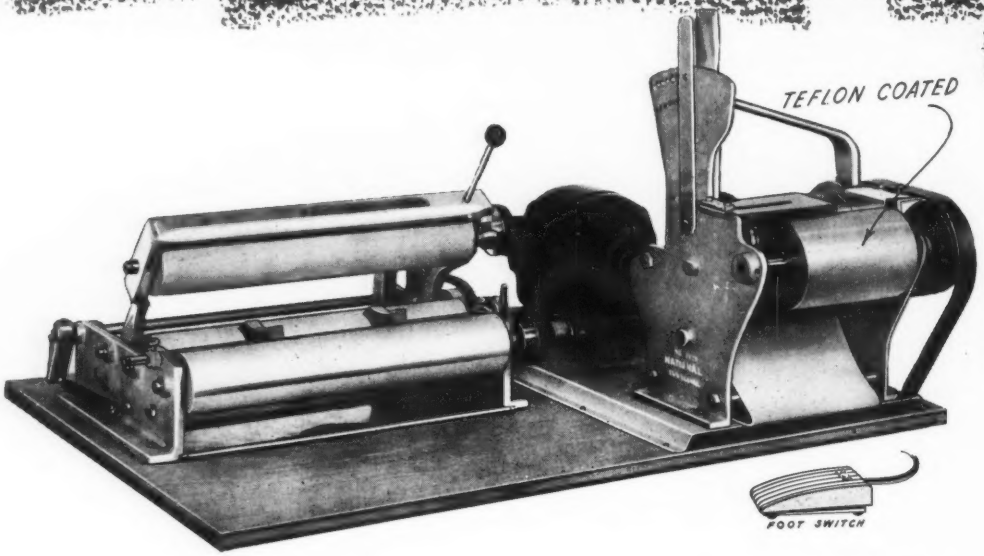
MINERAL OIL IN BAKING
BASIC FLAVOR RESEARCH
FLOUR SPECIFICATIONS AND METHODS

THE NATIONAL

SHEETING ROLL

with TEFLON coated rolls

Shown below in conjunction with
The THREE ROLL TYPE MOULDER



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TEFLON COATED SHEETING ROLL

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CEREAL CHEMISTS' EQUIPMENT MANUFACTURER

NATIONAL MFG. COMPANY

LINCOLN, NEBRASKA

INSIDE SCIENCE

THE VITAL STORY OF

Breakfast Cereals

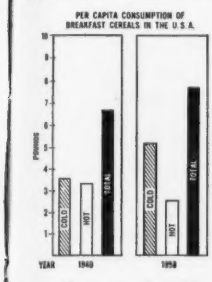
with essential vitamins and minerals restored

by Science Writer

New Edition

America Likes Breakfast Foods

The consumption of the dry type of cereals which are usually eaten cold has increased significantly. It shows a much higher rate of increase in recent years. For instance, in 1958 the per capita consumption of the cold type was 5.1 pounds as compared with 3.5 pounds in 1940. On the other hand, the hot type fell off from 3.2 pounds in 1940 to 2.5 pounds in 1958. Total consumption in this same period increased from 6.7 pounds in 1940 to 7.6 pounds in 1958.



Why are breakfast cereals so well-liked? They are tasty; they are easily served; they appeal to busy homemakers, as well as institutional dietitians, because they are readily available in a variety of flavors at a modest cost. They add interest and value to an important but sometimes neglected meal—breakfast. Their use is extending to between-meal and party snacks, too. Many grains are processed to make breakfast cereals: wheat, corn, oats, rice. Eaten with fruit and milk or light cream, they contribute an excellent combination of basic, flavorful, nutritious foods to the diet.

Better Foods for Better Health Through Restoration

The science of nutrition has advanced rapidly. In the manufacturing process of some cereals, some of the essential "B" vitamins and minerals are subject to some loss, just as with other foods. These losses are inescapable when such grains are prepared for human use. When this became known, manufacturers acted to overcome the losses. They adopted restoration.

Restoration simply means that certain important vitamins and minerals are restored to the cereal food during processing, so that the vitamin and mineral values in the finished product are generally equal to the whole grain values of those elements. Wheat, corn and rice products are customarily so treated. Vitamins B_1 (thiamine), B_2 (riboflavin), niacin (another "B" vitamin), and the mineral, iron, are those most widely restored. Vitamins C and D are also sometimes added.

Pre-sweetened cold cereals emphasize the nutritional importance of added vitamins. Increased calories require more "B" vitamins for best utilization of the food.

Why the Vitamins are Important

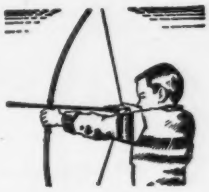
Physicians and diet experts have proved that vitamins are essential to prevent certain deficiency diseases and to contribute to robust good health.

Vitamin B_1 (thiamine) helps build and maintain physical and mental health. It is essential for normal appetite, intestinal activity, and sound nerves. A lack of this vitamin leads to beriberi, a rarity in the U. S. A., but still a very serious health problem in other parts of the world.

Vitamin B_2 (riboflavin) is essential for growth. It helps to keep body tissues healthy and to maintain proper function of the eyes.

Niacin is needed for healthy body tissues. Its use in the American diet has been largely responsible for the virtual disappearance of pellagra, a serious disease.

Vitamin D helps children develop normal teeth and bones. It prevents the development of certain abnormal bone conditions in adults.



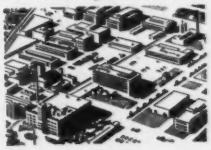
Iron is essential for making good red blood and for the prevention of nutritional anemia.

Where Do the Vitamins Come From?

At about the same time that processing losses in breakfast cereals became known, other developments in the scientific world made available ample supplies of vitamins at economical prices. Thus, the nutritional contribution of some breakfast cereals could be, and was, greatly improved through restoration.

Since the early days of breakfast food restoration and of white flour and white bread enrichment, the world-famous firm of Hoffmann-La Roche has supplied top quality vitamins *by the tons.* Pioneering work in its laboratories and by its collaborators resulted in the "duplication" of some of nature's extremely complex substances. First, the chemical composition of the vitamin was learned. Second, the pure substance was isolated. Third, the "duplicate" was made by synthesis. And fourth, the laboratory techniques were extended to large scale commercial operations.

The manufactured "duplicate" is identical chemically and in biological activity with nature's own product. A vitamin is still a vitamin regardless of whether nature or man made it. So efficient is large-scale manufacturing, that vitamins are sold at a lower cost than if they were extracted from natural sources.



This article is one of a series devoted to the story of vitamin enriched or restored cereal products: white flour, white bread and rolls, corn meal and grits, macaroni products, white rice, breakfast cereals, farina. Reprints of this article, of any other in the series, or of all are available without charge. Please send your request to the Dept. of Education, Fine Chemicals Division, Hoffmann-La Roche Inc., Nutley 10, N. J. In Canada: Hoffmann-La Roche Ltd., 1956 Bourdon Street, St. Laurent, Montreal 9, P. Q.

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Note: Base Flavor #103 or #104 blended with lemon or orange or spice creates a mellow richness to the blend that is indefinable but "OH SO DELICIOUS".

—Liberal Test Sample on Request—
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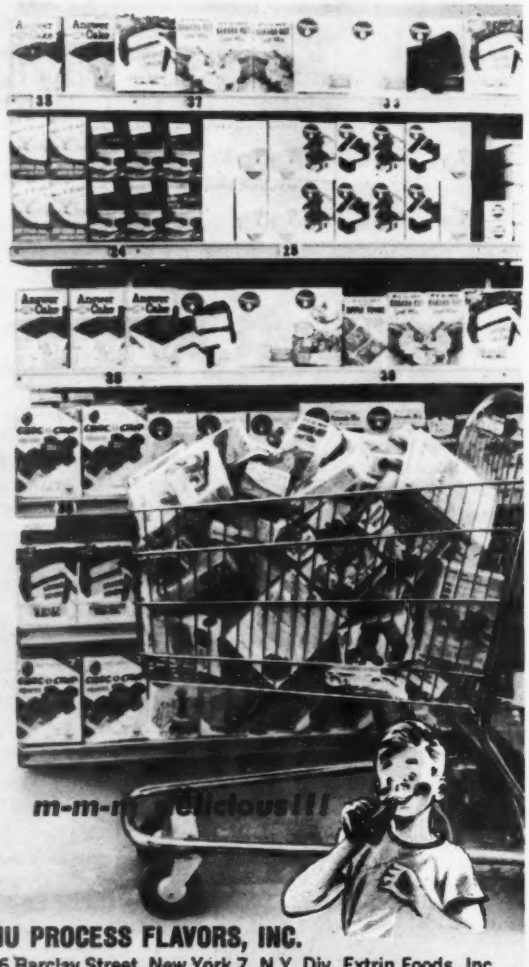

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American Association of Cereal Chemists

PURPOSE OF THE ORGANIZATION

The American Association of Cereal Chemists is devoted to: 1) the encouragement of scientific and technical research on cereal grains and their products; 2) the study of development and standardization of analytical methods used in cereal chemistry; 3) the promotion of the spirit of scientific cooperation among all workers in the field of cereal chemistry; 4) the maintenance of high professional standards of its membership; and 5) the encouragement of a general recognition of the value of the chemist and biologist to the cereal industries.

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Membership in the AACC is open to professionally qualified individuals anywhere in the world. An application form for membership may be obtained by writing the American Association of Cereal Chemists, 1955 University Avenue, St. Paul 4, Minnesota.

VOLUME 5 • NUMBER 8 • OCTOBER 1960

CEREAL SCIENCE today

FEATURES

White Mineral Oil in the Baking Industry. Raymond T. Bohn 234
Basic Flavor Research. Emily L. Wick 240
Corn Wet-Milling — Process and Progress. J. W. Evans 243
AACC Flour Specifications and Approved Methods 245
AACC Pesticide Residue Committee Report. E. E. Chapman, H. L. Marks, J. F. Wintermantel, and Warren O. Edmonds 249
Ten Steps for Survival 254

DEPARTMENTS

Editorial 233
People, Products, Patter 256
President's Corner 259
Book Reviews 263
Laboratory Helps and Gadgets .. 259
AACC Local Sections 260
Feed Technology 260

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CEREAL SCIENCE Today is published ten times per year (monthly except June and August) by the American Association of Cereal Chemists, from 500 South 5th Street, Minneapolis 15, Minnesota. Editorial, Circulation and Advertising Headquarters: 1955 University Avenue, St. Paul 4, Minnesota. Second class postage paid at Minneapolis, Minnesota.

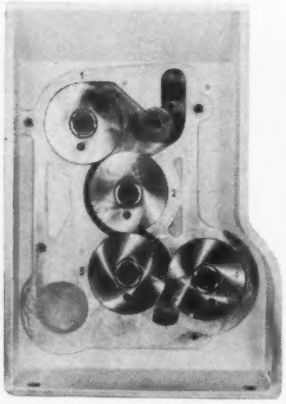
The American Association of Cereal Chemists assumes no responsibility for the statements and opinions advanced by contributors to its publications. Views expressed in the editorials are those of the editors and do not necessarily represent the official position of the American Association of Cereal Chemists.

Subscription rates: 1 year, $3.00; 2 years, $5.00; 3 years, $7.00. Foreign postage: $1.00 per year extra. Back issues available on request. Single copies: 35 cents.

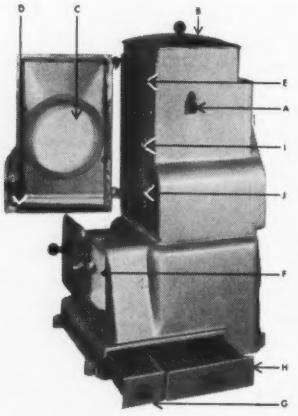
CHANGE OF ADDRESS: Notify Circulation Department, American Association of Cereal Chemists, 1955 University Avenue, St. Paul 4, Minn. Include both old and new addresses and postal zone number, if any. Claims for missing numbers will not be allowed if received more than 60 days from date of mailing plus time normally required for postal delivery of journal and claim. No claims allowed when subscriber has failed to notify the Circulation Department of a change of address, or because copy is "missing from files."

WHAT'S ALL THE LOOKING ABOUT?

The center of interest at the recent AACC exhibit is the revolutionary, new C.W.B. Quadruplex Pilot Mill. And, the enthusiastic reception proves, again, that C. W. Brabender Instruments are first choice of the cereal industry. It's this brand of creativity, quality and application help, that has made C.W.B. the leader!



The quadruplex system of corrugated precision ground rolls — CORRUGATED AFTER ROLL HARDENING.



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Editorial

GOOD SCIENTIFIC WRITING, like other outstanding literature, possesses an enduring quality that may become more apparent with the passage of time. Recently, we had the pleasure of becoming acquainted, through a paperback reprint, with a book that had long been out-of-print. It was C. V. Boys' "Soap Bubbles and the Forces Which Mould Them." The author was a renowned British scientist who first presented this material as a series of three lecture-demonstrations before a juvenile audience in London over seventy years ago.

This small volume should have appeal for anyone having scientific curiosity. No doubt most readers will want to try some of the ingenious experiments described therein. It should hold special interest for cereal chemists who have pondered over the behavior of bubbles in batters and doughs.

The book is one of a series, mostly in the field of physics, that is being reprinted to make these classics in science literature more readily available. Those responsible for this undertaking are to be commended for their efforts. Abstracts, reviews and reference books are essential in today's complex scientific world. Still, they cannot completely substitute for the experience of going back and reading those publications that originally opened up new areas of investigation or revealed new vistas of understanding. To try this out, browse through some of the earlier volumes of Cereal Chemistry.

PAUL E. RAMSTAD

A THOROUGH DISCUSSION OF

White Mineral Oil in the Baking Industry

By Raymond T. Bohn, Bohn Food Research, Inc., Scarsdale, N. Y.

WHITE MINERAL OIL has been used in the baking industry as an adjunct to efficient operation since mechanical devices for preparation and handling of dough were introduced. There is however, little reference to it in the literature of baking technology in the United States. Acceptance of mineral oil as the most efficient lubricant for dough dividers is evidenced by the fact that it has never been discussed at any of the thirty-five annual conventions of the A.S.B.E. F. C. Reichert refers to the importance of mineral oil as a lubricant for a dough divider in bulletin No. 2 of the American Society of Bakery Engineers published in 1924 (10).

In 1948 J. B. M. Coppock and M. A. Cookson reported (4), on behalf of the British Baking Industries Research Association, the views of the Council of that organization on the use of mineral oil for bread processing, which were based on research into method of analysis, etc., made by the research group. This study was reported further in 1949 by Coppock and Cookson (5). Since then M. A. Cookson reported on additional studies (3). Coppock and Knight discussed the present situation in 1957 (6) and in 1958 (7).

It is the purpose of this paper to assemble unpublished data currently available in the United States. The attention focused on the use of white mineral oil in the baking industry as a result of the Food Additives Amendment to the Food, Drug, and Cosmetic Act of 1938 makes this of interest to bakery management, cereal chemists, and production personnel.

White Mineral Oil, a Food Additive

White mineral oil, as used in the U. S. baking industry, comes under the definition of a food additive as described by the amendment to the Federal Food, Drug, and Cosmetic Act. It is not added as an ingredient of baked foods, but when used as an adjunct to efficient processing it can migrate into the finished product. Two problems, therefore, concern the baking industry. One is the purity of a white mineral oil suitable for use in food processing. The second deals with the amount of oil contained in the baked food and the reasonable maximum under which bakers can operate.

The quantity of mineral oil that should be permitted in baked products, from the standpoint of its safety as a food additive, is not the responsibility of the production men, but will be established by Food and Drug Administration acting under the Food Additive Amendment, after due consideration of all the facts in biological studies available.

A discussion of the factors involved in determining the safety of mineral oil in foods is beyond the scope of this paper. For those interested, R. E. Eckardt and L. C. McTurk of Esso Research and Engineering Co. have prepared a review of the literature[1] for the Council on White Mineral Oil covering these points: a) Is mineral oil absorbed out of the gastrointestinal tract, and if so, to what degree; is it toxic in this amount, and is it metabolized? b) Does mineral oil interfere with the absorption of nutrients from the gastrointestinal tract, especially the fat-soluble vitamins? c) Is mineral oil of USP or NF quality carcinogenic?

Tolerances for Mineral Oil in Food

The problem of trace quantities of mineral oil in food, particularly in bread, has been discussed for many years. Basing its decisions on the research in analytical methods and quantities necessary in good bakery operation done by Coppock and Cookson at the British Baking Industries Research Association (4) and on recommendation of the Council of that organization, the British Ministry of foods issued a Mineral Oil in Food Order in 1949. This order allows a maximum of 2000 p.p.m. by weight of mineral oil derived from its use as a lubricant for equipment or baking tins.

The Canadian Food and Drug Administration stated, in regulations issued in 1954, that "a food is not adulterated by reason only that it contains mineral oil not exceeding 3,000 p.p.m., if good manufacturing practice requires its use."

In the United States, the FDA has granted an extension for the use of white mineral oil by food manufacturers under the Food Additives Amendment, which permits its use in the baking industry until March 5, 1961 as a dough divider oil, pan oil, and trough grease, provided the oil is not present in the finished product in amounts exceeding 1500 p.p.m. (1); or until regulations are established, if before that date. This extension was authorized to provide time for completion of studies under way and preparation of petitions for tolerance under the Food Additives Amendment.

[1] Eckardt, R. E., and McTurk, L. C. Consideration on the safety to public health of the inclusion of white mineral oil in food. Council on White Mineral Oil, Room 2218, 15 W. 51st St., New York 19, N.Y.

Baking Industry Uses

White mineral oil has the following applications in the baking industry:

1) As a lubricant for dough dividers;
2) As a constituent of the oil used as a release agent for (a) bread pans, (b) cake pans;
3) As a component of trough grease.

Dough Dividers. All bread dividers operate on the principle of volumetric measurement of the the dough, by means of pockets and plungers, into pieces of desired weight. The plungers are adjusted to change the space in the pocket and hence the volume of the dough it receives.

Weights and measures laws of states and municipalities throughout the country are strict on tolerances of bread weights. Correct weight of the dough piece is the determining factor in the efficiency of the dough divider, and to get the correct weight by means of volumetric displacement, the plunger must operate at close tolerance and the dough must flow evenly in the pockets. It is, therefore, of utmost importance that parts of the divider coming in contact with the dough be properly lubricated. To accomplish this a lubricant is pumped to the parts of the divider mechanism coming into contact with the dough, at the required rate. White mineral oil has been found the most efficient lubricant for this purpose. Because its properties (see section on "Properties," below) are those which the baking industry demands in a lubricant for a dough divider, it has been used for generations to the exclusion of vegetable and animal oils. Only small quantities of oil are required for efficient lubrication of a dough divider.

Pan Lubricants: (a) Bread. Modern pan-greasing equipment requires an oil that is liquid at room temperature and is of the proper viscosity to spray into a mist and adhere to the sides of the pan. Years ago bread pans were greased by hand or by inverting them over rotating brushes which the operator kept saturated with melted lard by a mechanical device. For efficient operation, the lard had to be kept above the melting point. The amount of lard used was often excessive because of the need to satisfy the oven dumper and to take care of irregularities in the pans due to use and abuse. As a result, the outside of the pans in time became coated with a gummy deposit of polymerized fat resembling varnish, which carbonized in the oven, and presented a serious cleaning problem. With continued use the residual fat became rancid and imparted an objectionable odor and taste to the crust of the bread.

Modern production methods utilize mechanical devices to dump the bread from the pan. To do this without damage to the bread, the pans must be well prepared. A silicone resin coating keeps the fat from saturating the pores of the tin making it possible to release the bread without a greasing material. Often a pan can be used many times before it must be greased and later recoated with resin. However, practical experience has shown that it is desirable to grease pans lightly before each use in order to utilize mechanical dumping devices and prevent damage to the bread.

Machines have been developed which automatically apply a measured amount of liquid lubricant. This lubricant may consist of mineral or vegetable oils blended with a white mineral oil of proper viscosity to hold the atomized lubricant on the sides of the pan. Neither animal or vegetable oils, nor mineral oils alone, are satisfactory. A combination of the two is the most efficient.

According to consumption and analytical data, the maximum transfer that might occur is 500 p.p.m. of white mineral oil, which is well below the level presently permitted by the Food and Drug Administration.

(b) Cakes. Cake pans, particularly those used for small items, must be greased rather heavily to permit mechanical dumping of the cakes. In large-scale commercial practice the pans are greased mechanically with semifluid blends of flour or starches, fat, and an emulsifying agent. Mineral oil helps functionally in maintaining the proper viscosity in materials designed for this purpose.

Trough Grease. Mineral oil performs a desirable function in the lubrication of troughs in which bread and roll doughs, often weighing as much as 1,000 lb., are fermented. The oil is employed as a component of mineral trough grease, as well as compositions containing vegetable or animal fats and oils. The trough grease prevents the dough from adhering to the surface of the trough. In certain operations a mixture of oils is sprayed on the surface of the troughs, in others a plastic blend of fat and oil is supplied. Proper viscosity of the grease is required for both types of operation. Mineral oil is not only an important adjunct for this purpose, but also helps to keep the troughs in sanitary condition and free of rancidity.

Determination in Baked Foods

The determination of mineral oil in baked products requires separation of the fatty substances in the bread from the gelatinized and dextrinized carbohydrates, denatured protein, etc. Direct extraction of the crumb with a solvent does not suffice. Coppock and Cookson (5) used cold carbon tetrachloride, followed by saponification of the oils extracted and separation of the unsaponifiable portion. This method, of course, does not extract all the oil, but these authors concluded that the mineral oil extracted was in constant proportion to the theoretical amount known to have been added. By reference to a graph experimentally developed, they calculated the percentage of mineral oil actually present. The percent of mineral oil extracted decreased as the concentration approached approximately 1,000 p.p.m., after which it was constant; but only about 60% of the oil was extractable. Using an acid-diastase-pancreatin treatment, Coppock recovered 85% mineral oil from test loaves.

Steam distillation of bread crumb dispersed in various solvents has also been tried, but none of the methods described is as accurate or as simple as the AOAC method for unsaponifiable residue in cereal foods (2). Modifications of this method have been found to give high recovery of mineral oil added to bread crumb.

In one modification the separ-

ated unsaponifiable mineral oil is weighed, and in another it is passed through an activated aluminum oxide column. Recoveries of 91 to 100% have been reported by these methods, on the basis of percentages of mineral oil present of 0.05, 0.10, and 0.20%, fresh bread basis. Adaptation of the AOAC method to bread by Wendell Reeder[2] based on the volumetric measurement of the separated mineral oil, gives 100% recovery of mineral oil added to the crumb. The method as used in the work reported in this paper is as follows:

Determination of Mineral Oil in Bread

Procedure: Transfer 100 g. air-dry bread to a 1-liter beaker. Add 200 ml. water and mix. Add 200 ml. HCl and mix. Lower the beaker into the steam bath, cover, and heat 1 hour with cocasional stirring (six or seven times). Cool in a water bath of 15° or less and stir. Add 20 g. Celite, or Hi-flor, and mix thoroughly.

Separation of Oily Constituents: Prepare a 13-cm. Büchner funnel by placing two 12.5-cm. Whatman No. 30 filter papers in the funnel and applying suction. Mix 20 g. filter aid with 100 ml. water and pour mixture into the funnel rapidly. Filter sample immediately. Rinse the beaker several times with ice water. Just before filtration is complete, wash funnel with about 200 ml. ice water or until filtrate is clear. Up to this point do not allow pad to suck dry. Continue suction until pad appears dry. Transfer to original beaker (minus filter papers), break up mass, and dry overnight on steam bath. Remove remaining moisture by heating in oven at 100° about 1 hour.

Extraction of Fats and Oils from Filter Aid:
Solvent: Petroleum ether (1 + 1).

Add 300 ml. solvent, mix thoroughly, and filter through 9.5-cm. fritted (coarse) glass funnel containing pad of asbestos 0.25 in. thick. Repeat extraction twice using 100 ml. solvent both times. Transfer filtrate to 600-ml. beaker and evaporate to small volume on steam bath. Transfer to 50-ml. Erlenmeyer flask. Rinse beaker with 20 ml. solvent and add to material contained in Erlenmeyer flask.

Saponification: Evaporate material in Erlenmeyer flask to remove solvent. Reflux 2 hours under air condenser with 3.0 ml. (3 + 2) KOH and 10 ml. alcohol.

Extraction of Mineral Oil: Add 15 ml. petroleum ether and transfer to separator. Add 20 ml. water and shake vigorously. Drain lower layer and transfer upper layer to another separator. Repeat extraction with 15 ml. petroleum ether and combine extracts. Wash extract twice with 3-ml. portions of water using gentle agitation. Wash once with 3 ml. 0.5*N* KOH, followed by vigorous agitation with successive 3-ml. portions water until washings are alkali-free. Filter extract through cotton plug and transfer to Babcock milk bottle and evaporate solvent on steam bath. Cool, add about 5 ml. Babcock H_2SO_4 (100 ml. conc. H_2SO_4 + 10 ml. H_2O–d 1.82–1.83), and place in boiling water for 30 minutes. Cool bottle and contents and fill with H_2SO_4 until surface rises well into graduated neck. Centrifuge at 1200 r.p.m. 5 minutes and read volume of unreacted residue.
(Babcock bottle: standard milk testing bottle, 18 g. sple. graduated in 8 units. 1.0% on scale = 0.20 ml.)

Calculation:
ml. × 0.88 = wt. g. mineral oil
g. oil = reading × 0.176

Bread made without mineral oil contains an appreciable amount of unsaponifiable matter. This may be as high as 0.02%, but as it cannot be separately determined in bread which has come in contact with mineral oil, it is reasonable to deduct 0.02 percentage points from the total unsaponifiables found in calculating the percentage of mineral oil present.

The refractive index of the unsaponifiables should be checked. It should be less than 1.5000 at 20° C., since white mineral oil has a refractive index of 1.4665 at 20° C.

Preparation

White mineral oil is prepared from crude petroleum by elaborate refining processes. The various reactive hydrocarbons and impurities which are responsible for color, odor, and taste in the crude oil must be removed in order for a white mineral oil to meet the requirements of the USP (11) and the National Formulary (9) and specifications for freedom from aromatics set by FDA.

Properties

White mineral oil is a colorless, transparent, oily liquid, free or nearly free from fluorescence. It is odorless and tasteless when cold and develops not more than a faint odor when heated. The USP (11) describes it and the National Formulary (9) outlines the tests for quality and purity to which it must conform.

In addition, white mineral oil must pass an ultraviolet absorbance test suggested by FDA (8) to demonstrate the absence of possibly harmful polynuclear aromatic compounds. It is available in a wide range of viscosities to meet the requirements of the food processing industry. USP oil has a Saybolt viscosity of above 178 seconds at 100° F.; the NF oil has a viscosity of up to 172 seconds.

Unique chemical and physical properties give the oil special functional properties for the food-processing industry not possessed by vegetable or animal oils. It is odorless and tasteless. It is resistant to oxidation and the development of rancid flavoring substances. It does not become gummy on continued usage as a lubricant of food processing equipment operating at high speed. White mineral oil is more difficult to emulsify than natural oils; this gives it special value as a lubricant for food processing equipment.

Specifications

White mineral oil, to meet the requirements of the baking industry, should conform to the following specifications:

Acid test (carbonizable substances): meets USP and NF requirements
Sulfur compounds: meets USP and NF requirements
Acidity and alkalinity: none (neutral)
Ultraviolet absorption (14).
at 275 mμ, 1-mm. cell, less than 0.3;
at 295–299 mμ, inclusive, 1-cm. cell, <0.225;
at 300–400 mμ, 1-cm. cell, <0.180
Saybolt color: 30 (colorless)
Odor: none
Taste: none
Solubility in water: none
Solubility in alcohol: none
Viscosity: as specified

Variation in Quantity of Oil Migrating into Bread

Since bread at the present time (1) may contain a maximum of 1500 p.p.m. of mineral oil, the quantity that may migrate into bread when it is used as a divider lubricant in good commercial practice is a matter of importance. To determine this, arrangements were made for a commercial bakery in which mineral oil was used only as a lubricant for the dough divider, to select four loaves at random for five consecutive days from regular production. These were wrapped in Cellophane and each loaf analyzed for mineral oil, using the method described above. Results are shown in Table I.

The mineral oil in the bread (38% moisture basis) varied from a low of 120 to a high of 2,100

[2] Reeder, W., Campbell-Taggart Baking Co., Box 2640, Dallas, Texas. Prviate communication.

Table I. Variation in Mineral Oil in Bread in One Bakery[a] (Reported on dry basis)

Bread Sample	Days 1	2	3	4	5
	ppm	ppm	ppm	ppm	ppm
A	1140	1340	1070	3240	1900
B	1520	1550	1060	1120	600
C	1910	1520	1950	1700	190
D	1610	1530	1540	0950	1460
Average	1550	1490	1400	1750	1040
(Bread, 38% moisture)	960	920	870	1080	650

Average 900

[a] Hazleton Laboratories, Falls Church, Va. Report of Council on White Oil.

p.p.m., with an average of 900 p.p.m. This variation is not unexpected. For example, at the beginning of a day's production or at a change in type of bread being made, the amount of mineral oil coming into contact with the dough may vary until proper adjustment has been made.

Analysis of a single loaf of bread, obviously, will not suffice to evaluate the quantity of mineral oil migrating into bread in commercial bakery operations. On the other hand, the number of loaves needed, according to statistical methods, would be too large to be practical as a means of control. A more reasonable approach is to use bakery production control figures on mineral oil usage. These are based on inventory figures on use of mineral oil and pounds of bread produced. This method is in general use in the industry.

The condition of the divider, regardless of its age, has an effect on the quantity of mineral oil migrating into bread. This is clearly shown in Table II.

Table II. Effect of Age of Divider on Mineral Oil Consumption[a]

Divider Make	Age	Mineral Oil in Bread
	years	ppm
1	14	500
1	14	600
2	21	600
3	12	1,000
1	6	1,200
2	3	1,500
2	24	2,500

[a] Reeder, W., Campbell-Taggart Baking Co., Dallas, Texas. Private communication.

It is evident that maintenance of the divider and care in regulating flow of oil can affect the mineral oil content of bread. The age of the divider could have a serious effect if it were not well serviced. Bakeries where usage figures are high must examine one by one the facts which affect oil consumption and take the measures necessary to bring usage figures within any tolerance that might be established.

MO in Bread from Use as Divider Lubricant

(a) By Bread Analysis.

Data pertaining to the variations that may occur in the amount of mineral oil in bread when the oil is used only as a divider lubricant were determined in two ways.

First: White bread made in bakeries (large and small) that used mineral oil exclusively for lubrication of the dough divider, was purchased in stores so located as to give a good cross-section of modern bread production in the United States. Table III reports the results of analysis calculated to 38% moisture basis.

The average of 17 bakeries was 900 p.p.m. with 11 of the 17 producing bread containing less than 1,000 p.p.m. of mineral oil. It is reasonable to expect that all the bakeries, with proper adjustment of the flow of mineral oil and efficient maintenance of the divider, should be able to operate within a maximum tolerance of 1,500 p.p.m. for the uses in bakery operations described by FDA (1).

Second: A survey by analysis of the mineral oil content of bread made in 62 bakeries of a large baking company using mineral oil only for lubrication of the divider gave the results reported in Table IV. Ninety-two percent of the bakeries operated with less than 1,500 p.p.m. mineral oil migrating into the bread.

(b) By Production Data. In good production practice, bakeries have

Table III. White Mineral Oil Content of Bread (by Analysis)[a]

Bakery	Mineral Oil 38% Moisture Basis
	ppm
1	1,850
2	1,660
3	830
4	765
5	1,000
6	1,070
7	475
8	3,360
9	235
10	290
11	1,350
12	720
13	240
14	226
15	117
16	298
17	880
Average	904

[a] Hazleton Laboratories, Falls Church, Va. Report to Council on White Oil.

Table IV. Mineral Oil in Bread (by Analysis)[a]

No. of Bakeries	Mineral Oil (Fresh Bread Basis)
	ppm
2	400
7	500
13	600
2	700
4	800
8	900
6	1,000
5	1,100
5	1,200
1	1,400
4	1,500
1	1,800
1	1,900
1	2,100
1	2,400
1	2,500

[a] Reeder, W., Campbell-Taggart Baking Co., Dallas, Texas. Private communication.

no trouble producing bread within the maximum of 1,500 p.p.m., using mineral oil as divider oil. This is indicated by control data reported by many important members, both large and small, of the baking industry. The data given in Table V are actual usage figures for a number of companies, some of which operate dozens of bakeries.

Usage figures will not reflect the variation that may occur in mineral oil content of individual loaves produced in these bakeries. They will serve as a practical way for the baker to control the use of mineral oil within the tolerances established by FDA.

Table V. Mineral Oil Used for Lubrication of Divider (Based on Actual Production Figures)

Company	*Oil in Bread*
	ppm
1	600
2	750
3	1,100
4	200
5	850
6	500
7	600
8	800

MO in Sweet Yeast-Raised Products

Mineral oil can also migrate into sweet doughs which are scaled volumetrically as in the case of bread doughs, or extruded. In either case the quantity used need not exceed 1,500 p.p.m.

MO in Buns

(a) By Analysis. Soft buns, such as hamburger and frankfurter rolls, as well as many types of hard rolls, all of which come under the Standards of Identity for bread, are also divided mechanically into pieces of proper weight. Mineral oil is used as a lubricant or release material. Two makes of dividers are most popular for this purpose. For one an oil of higher viscosity is preferred, but its use does not increase the average mineral oil content. Table VI groups the number of bakeries into those which had the indicated percentages of mineral oil in hamburger buns as determined by analysis.

Table VI. Mineral Oil Content of Hamburger Buns[a]

No. of Bakeries	*Mineral Oil*
	ppm
7	300
20	400
12	500
8	600
6	700
2	800
4	900
1	1,000
2	1,200

[a] Reeder, W., Campbell-Taggart Baking Co., Dallas, Texas. Private communication.

Values range from 300 to 1,200 p.p.m.; average 540 p.p.m. for 62 bakeries.

Similarly, hamburger buns were purchased in various sections of the country and analyzed for mineral oil content. The average of six different brands was 460 p.p.m.

(b) By Usage. In good production control it is a simple matter to keep separate records of the mineral oil used in buns and that used in bread. Consumption figures obtained in this manner from bakeries producing buns exclusively, or in which buns are a substantial part of the production, indicate that in efficient operation the buns will not contain more than 1,000 p.p.m. mineral oil.

Pan Oil

Analytical data on bread which had come in contact with mineral oil only as a constituent of pan oil indicates the maximum transfer which might occur in good operating practice would be 500 p.p.m.

Mineral oil migrating into the bread in commercial production can be calculated (in p.p.m.) from consumption data. To do this the percentage of mineral oil in the proprietary pan oil must be known to the baker. Production control data confirm the experimental test and analytical results that the mineral oil in pan oil will not impart over 500 p.p.m. to bread.

Trough Grease

Consumption data indicate that only a small amount of lubricant (0.02 to 0.05%) is necessary for efficient lubrication of the surface of a trough. Not all of this migrates into the bread. Commercial trough grease varies in mineral oil content. If it contained as much as 50% mineral oil, the quantity of oil in bread could vary, up to 250 p.p.m.

Summary

White mineral oil for use in the bakery is a highly refined petroleum product conforming to USP and National Formulary specifications as well as ultraviolet absorbance tests.

The mineral oil content of bread in a test run of one week in a well-operated bakery was found to vary from 120 to 2,100 p.p.m. with an average of 900 p.p.m.

The age and condition of the dough divider has been shown to have an effect on the mineral oil content of bread. An old divider, if efficiently maintained, will not use more oil than a newer one.

The mineral oil content of bread purchased in stores in various sections of the country varied from 117 to 3,360 p.p.m., with an average of 904 for bread made by 17 different companies.

In a survey of 62 bakeries of a large company, 92% produced bread with less than 1,500 p.p.m. mineral oil.

Production control figures serve as a practical way for the baker to control the use of mineral oil. Data from eight companies operating hundreds of bakeries showed a variation of 200 to 1,100 p.p.m. mineral oil used as divider oil.

Analysis and consumption figures for the use of mineral oil on bun dividers are practically the same as for bread. Analysis of buns made in 62 bakeries showed a variation from 300 to 1,200 p.p.m. with an average of 540 p.p.m. Analysis of buns purchased in stores showed an average of 460 p.p.m. Consumption figures indicate buns will not contain over 1,000 p.p.m. mineral oil.

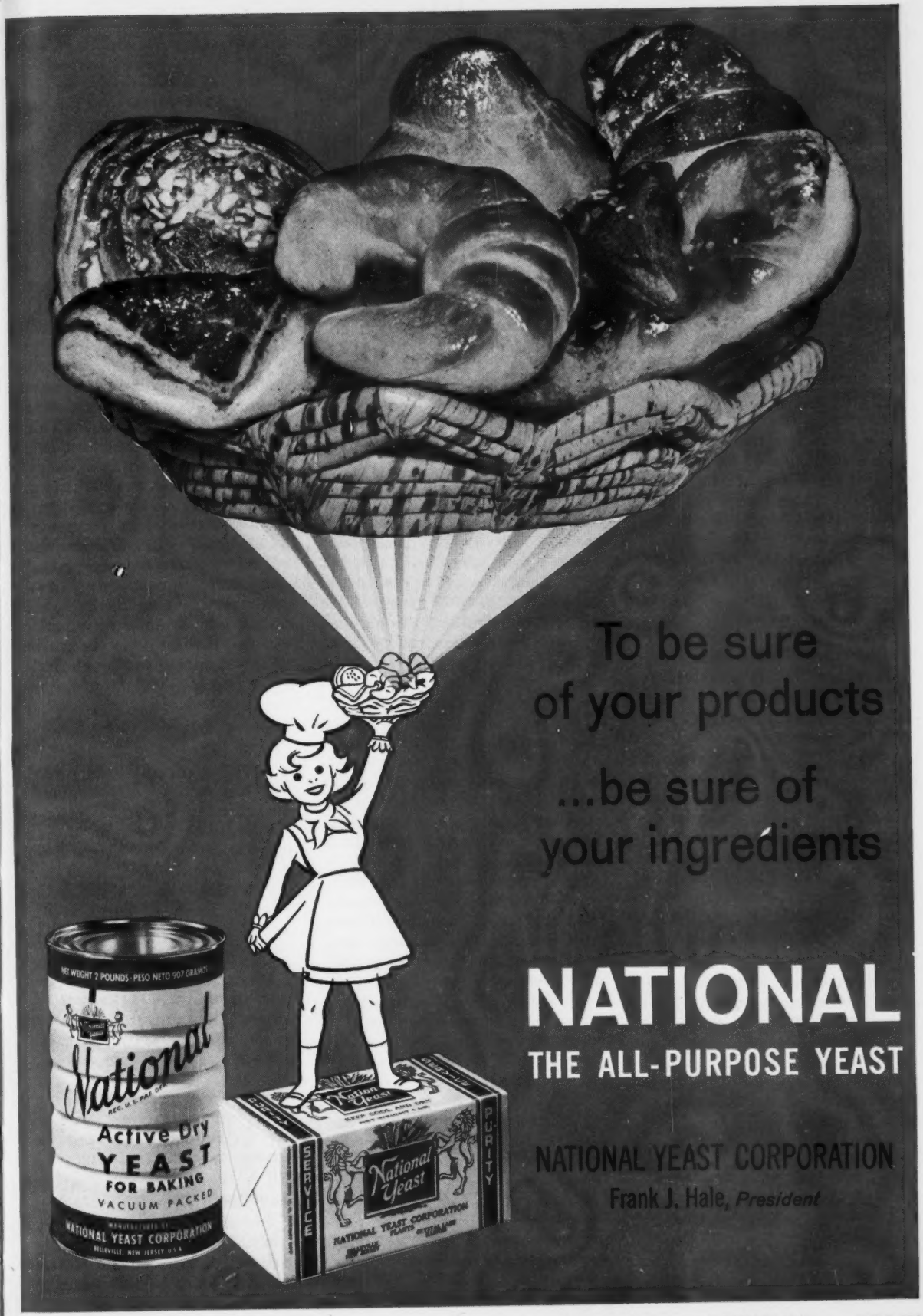
The quantity of mineral oil migrating into bread from its use in pan oil is approximately 500 p.p.m. If used in trough-greasing materials, the quantity will be about 250 p.p.m.

Acknowledgment

We are indebted to the Council on White Mineral Oil, to Wendell Reeder of Campbell-Taggart Baking Co., to O. E. Paynter of Hazleton Laboratories, to many friends in the research laboratories of baking organizations, and to production executives for their help in making available research and production data.

Literature Cited

1. Anonymous. Food additives, Part 12. Federal Register (March 17, 1960).
2. Association of Official Agricultural Chemists. Official methods of analysis (8th ed.), p. 231. The Association: Washington, D.C. (1955).
3. Cookson, M. A. Thesis, Univ. of London, October 1955.
4. Coppock, J. B. M., and Cookson, M. A. *Bakers' Nat'l Assoc. Rev.*, p. 1194 (Dec. 17, 1948).
5. Coppock, J. B. M., and Cookson, M. A. *J. Soc. Chem. Ind. 68:* 274 (1949).
6. Coppock, J. B. M., and Knight, R. A. *Chem. & Ind. (London) 1957:* 521.
7. Coppock, J. B. M., and Knight, R. A. *Chem. & Ind. (London) 1958:* 1419.
8. Haenni, E. O., and Hall, M. A. *J. Assoc. Offic. Agr. Chemists 43:* 92 (1960).
9. National Formulary (11th ed.). Washington, D.C. (1955).
10. Reichert, F. C. Bull. 2, Am. Soc. Bakery Engineers (1924).
11. U.S. Pharmacopeia (16th rev.). Easton, Pa. (1955).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PROBLEMS AND POSSIBLE APPROACHES IN Basic Flavor Research[1]

By Emily L. Wick, Assistant Professor of Food Chemistry, Department of Food Technology, Massachusetts Institute of Technology, Cambridge, Mass.

THE GOAL OF basic flavor research is to determine the identity and quantity of the chemical substances present in a foodstuff which cause it to possess or exhibit its characteristic flavor. This appears, at first glance, to be obvious, simple, and straightforward. However, serious consideration, in particular of how this goal is to be accomplished, leads to the conclusion that difficult problems are involved.

Preliminary Problems

The chemist first asks himself: What quantity or yield of a flavorful mixture can I hope to isolate from this foodstuff? Will it be just a sniff? Five or six milligrams? One hundred milligrams? Several hundred milligrams? Or as much as a gram? The answer is important, because it determines the analytical method which may be applied to separation of the flavor components and, consequently, the rigor with which identification of these components is made.

It is well known that flavor compounds make up a very small percentage of a food; yields of flavor isolates of 0.001 or 0.0001% are not unusual. Thus, to obtain 100 mg. of a total mixture of flavor compounds, anywhere from 20 to 200 lb. of a foodstuff may have to be processed. Recently I have heard of ten tons of a fruit yielding 15 g. of flavorful oil, and one ton of a vegetable giving 0.5 g. of a flavorful mixture. The chemist usually decides to be satisfied with whatever yield results from the largest quantity of foodstuff that he is equipped to process.

A second question is: Is the flavor under investigation primarily an aroma, a taste, or a combination of both? Aromas are generally made up of very volatile substances. Taste may be either volatile or nonvolatile. The basic tastes—sweet, salty, sour, and bitter—are often caused by nonvolatile compounds. If the flavor under investigation is mostly aroma and is therefore volatile, the problem is simplified. A flavor isolate can then be removed from noncontributing substances such as protein, carbohydrate, and fat. Its components can thus probably be isolated by distillation and separated by gas chromatography. If, on the other hand, the flavor is primarily a taste, or is perhaps a feeling factor such as that sometimes called "mouthfulness," the problem is much more complicated. Separation of such flavor components from the major food constituents must depend upon methods such as fractional precipitation or liquid chromatography.

Perhaps the best friends a chemist can have at the beginning of a flavor investigation are a group of people wise in the attributes and characteristics of the flavor in question, who can, by organoleptic evaluation, help him to make the basic decision as to whether the volatile or the nonvolatile compounds, or both, must be studied.

From the above remarks it should be clear that the first requirement for success in basic flavor research is the isolation of a true flavor extract in as large amount as possible from the food under investigation. The second requirement is separation of the flavor extract into its individual components, and the third is unequivocal identification of the components thus separated. The fourth and final requirement is that a recombination of the compounds so identified yield a mixture which exhibits, after appropriate dilution, the original flavor of the foodstuff being studied. To this author's knowledge, this final requirement has never been completely achieved, although it has been closely approximated.

Isolating a True Extract

The isolation of a true flavor extract is generally attempted by one or more of the following methods: distillation, extraction, or entrainment by means of an inert gas. Entrainment is successful only when a very volatile aroma is being studied. Components are isolated by means of chemical traps or by condensation at very low temperatures.

Direct extraction of the foodstuff under study, by means of a solvent, often provides mild as well as efficient removal of flavor. This method is, however, not always advantageous, since large quantities of substances such as lipids are often extracted along with the flavor components. In this case, further separation, during which extensive deterioration of flavor components may occur, is necessary.

Distillation is probably the most useful method for separating flavor components from nonflavorful constituents of food. It applies, of

[1] Presented at the 45th annual meeting, Chicago, Illinois, May 1960.

course, only to the isolation of relatively volatile flavors. However, most flavors are sufficiently volatile to be removed from the great majority of noncontributing substances by this means. Distillation is often carried out under conditions of low temperature and high vacuum yielding an aqueous solution of flavor components which has undergone little or no deterioration due to processing conditions.

Opportunity for deterioration of the flavor isolate occurs during removal of the flavor compounds from the aqueous distillate. The method of removal is usually either 1) formation of stable derivatives of the components present, or 2) direct solvent extraction after the distillate has been saturated with an inorganic salt. In the latter case the resulting solvent extract must be concentrated by careful fractional distillation to a minimum volume and the yield of the total flavorful mixture determined.

Both methods have disadvantages, as well as advantages. The formation of solid derivatives allows the removal, in usually stable form, of compounds of a selected chemical type such as carbonyl compounds. It is, however, difficult to determine to what extent the derivatized compounds contribute to the odor or flavor of the food being investigated. On the other hand, solvent extraction allows easy evaluation of odor, but it affords great possibility for deterioration of the flavor compounds. In actual practice, it is often necessary to use both methods.

Separating into Components

Separation of flavor concentrates into their individual components has been very greatly aided in recent years by the use of chromatography in all its forms. In cases where derivative formation has been used to isolate flavor components, chromatography is employed, both liquid and paper. When a direct solvent extract has been isolated, gas chromatography is the method of choice. Gas chromatography has received deservedly wide publicity for the way in which it has revealed the large number of compounds present in flavor isolates. At the recent meeting of the American Chemical Society in Cleveland Dr. Teranishi of the Western Regional Laboratory of the U.S. Department of Agriculture amazed his listeners by showing a chromatogram of 50 μg. of strawberry oil which contained roughly 100 peaks. It appears that even though approximately 40 components of strawberry oil have been identified, many remain unknown

The fact that so many components can be detected in such a small sample is truly a wonderful thing. Of equal interest, however, is the fact that the same sample of strawberry oil, when separated on a different gas-chromatographic column and under different conditions, contained a greatly reduced number of components. This fact should serve to remind all of us who are engaged in flavor research that what appears to be a single peak on a chromatogram may actually contain a number of substances. This is well known, but the temptation is great, when flavor isolates are so laboriously obtained, to succumb to wishful thinking and tentatively identify such peaks by comparison of retention times with those of known compounds.

It is desirable, if possible, to obtain a sufficient quantity of flavor concentrate to allow its separation into acidic, basic, and neutral components before analysis by gas chromatography or derivative formation is carried out. Such a separation is illustrated in the diagram. By this means "submixtures" of a generally similar and known chemical type may be obtained. Subsequent examination of these relatively simple mixtures by formation of derivatives and chromatographic separation, or by direct gas-chromatography, permits this versatile technique to function even more efficiently.

An example of the combined use of chemical separation such as that shown in the diagram, followed by gas chromatography, is the work of D. E. Smith and J. R. Coffman of General Mills Laboratories, in their study "The neutral volatiles from bread pre-ferment liquid." Their investigations were reported at the recent American Chemical Society meeting.

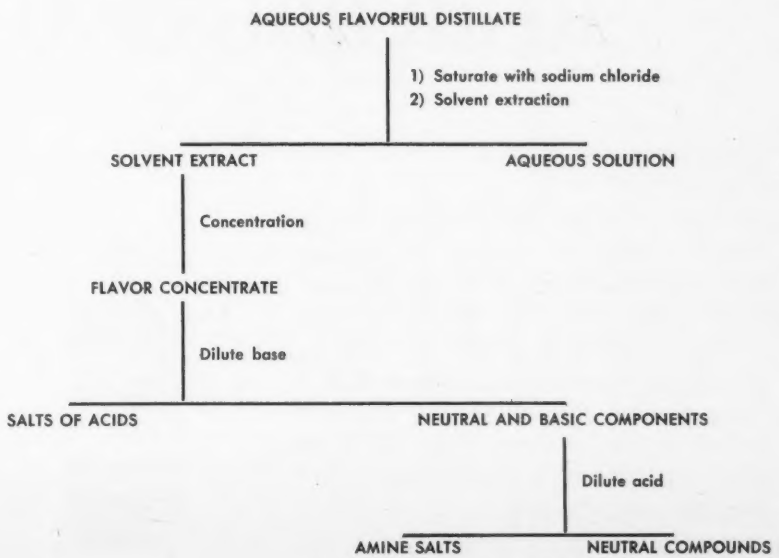
On the other hand, the use of derivative formation after preliminary chemical separation is illustrated by the work of Wiseblatt and Kohn on the volatile aromatic compounds present in fresh white bread (1).

Identifying Components

The identification of each component of a flavor extract as a known chemical compound may be made in a number of ways. The method chosen depends directly on the amount of the component available after it has been sepa-

(Please turn to page 258)

A Possible Separation Scheme



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A LITTLE-KNOWN "LITTLE GIANT" OF INDUSTRY

Corn Wet-Milling—Process and Progress

By J. W. Evans, American Maize-Products Company, Roby, Indiana

THE CORN WET-MILLING or refining industry is one of moderate size which has grown in its 60 years' existence to use approximately 4% of the total annual corn crop or approximately 20% of the total cash value. It is composed of nine companies which each year convert over 145 million bushels of corn into products having a sales value of over 500 million dollars.

The major purpose in corn refining is to obtain from the corn kernels pure starch containing a minimum amount of protein and other impurities. In the United States this industry is producing annually almost 5 billion pounds of refined corn starch of which 2.25 billion pounds are consumed as starch of the various types, 1.5 billion pounds are converted to corn syrups, and 1.25 billion pounds are converted to corn sugars.

Complexities of refining steps and products account for the well-equipped and well-staffed control, development, and research laboratories maintained by each of the companies of the industry. Over and above these efforts, the Corn Industries Research Foundation, Inc., arranges for fundamental research on problems of common interest to the industry. Plant or production engineers are an important segment of the technical staffs of each company.

While the major portion of corn used is of the regular variety, there are instances where corn-refining steps might be considered to start in the cornfield. Waxy corn, whose starch is composed entirely of the amylopectin fraction, and Amylomaize, whose starch contains about 60% or over twice the amount of amylose normally present in corn starch, are good examples. Research on the genetic aspects of starch composition and properties is being continued by the U.S. Department of Agriculture, by experiment stations, by seed corn producers, and by one or two companies in the corn-refining industry. Waxy corn and milo starch are commercial products; the Amylomaize or high-amylose starch is in the process of becoming commercial, to the extent that seed is available.

The manufacturing steps employed in corn refining will be described and improvements discussed.

Steeping

Shelled corn, as received, is cleaned and placed in vertical tanks where it is soaked or "steeped" for about 40 hours in warm (120°–130°F.) sulfurous acid (0.15–0.3% sulfur dioxide) solution. The warm sulfurous solution softens the hull, loosens the protein-starch complex by dissolving cell walls and cementing materials, helps extract soluble matter, effects a chemical modification of the starch, and prevents undesirable bacterial fermentation.

This steeping step delays production 40 to 50 hours, which, for a 50,000-bushel-per-day plant, necessitates a hold-up of over 50,000 bushels of corn in the steeps. Despite the work of many people over the past thirty years in an effort to shorten or eliminate the steeping step, it still remains an essential and vital part in the technology of corn refining. Control of quality of starch and yield starts in this step.

The effect of the sulfurous acid steep in corn wet-milling was studied by Mary J. Cox, Majel M. McMasters, and G. E. Hilbert (1). Methods were developed and used for following *in situ* changes occurring in structural protein and for removing starch granules from a section of the kernel to leave the protein network clearly visible.

Stanley A. Watson and co-workers have published a series of articles relating to steeping (5,6,7). They developed laboratory methods and studied the commercial steeping process.

As the result of laboratory, pilot-plant, and plant studies of steeping conditions have been changed over the years to improve milling and separation properties. Condition and type of corn is followed closely in order to make desired adjustments. New problems and conditions continue to arise as a result of climatic and storage changes. A "steeping expert" can never rest on his laurels.

Degerminating

When the desired degree of steeping is achieved the "steepwater" is drawn off, concentrated, and added to corn protein and hull to make animal feeds, or sold as such.

The steeped corn is conveyed to disintegrating mills which tear the kernels apart to free the germ and loosen the hull. The wet mass of shredded kernels with added water is transferred into tanks called germ separators. The lower specific gravity of the oil-bearing corn germ makes possible separation by flotation. The corn germs float on the surface and are skimmed off, while the other particles settle and are

drawn off at the bottom of the separators. Specific gravity of the suspended mass is carefully controlled by addition of starch slurry so as to obtain efficient separation. The separated germs are washed, dried, and extracted. Corn oil is refined and used extensively as a cooking and salad oil. The non-oil residue is a desirable and valuable animal feed component.

Changes in the degerminating steep have related to design of equipment and materials of construction. Stainless steel is replacing wood.

Separation of Hull and Fiber

The mixture of starch, gluten, and hulls remaining from the germ separation step is finely ground in stone or steel mills of special design. This is wet-milling, as the mixture passing through the mills is in a water-slurry form.

The milling step controls in a large degree the yield and quality of starch obtained from the corn. It not only has received a great amount of attention, but continues to do so. Originally "special-cut" or -designed stones were used. These were replaced almost entirely by carborundum stones, and double-disk steel mills and impact mills have come into use more recently.

The problem is to free the starch from protein and hull so it can be separated by sieving, washing, and centrifuging. Too fine a grind of the hull presents problems in washing starch from fiber and in too high a fiber content in the starch. It is necessary, however, to break up the starch-protein matrix.

After milling the wet mass is washed through a series of shakers to remove hull and coarse particles of the endosperm. The shakers are dressed with nylon or silk bolting cloth. A trip through one of the modern milling departments of the industry will highlight improvements in this area. The old, open wood frame shakers have been replaced with more efficient closed stainless-steel ones. These not only have improved efficiency but have made working conditions much better.

The hulls and grits, with concentrated steepwater, become components of animal feeds.

Centrifugal Separation of Starch from Protein

At this point solubles, germ, hull, and residual "grits" have been removed to leave a suspension of protein and starch. At one time the separation of starch from protein was done entirely by running the slurry through slightly inclined shallow, flat-bottomed troughs which were about 2 ft. wide and 100 ft. long. Starch particles having a higher specific gravity were deposited on the trough bottom while the protein flowed over the end. Starch was first removed from the so-called starch tables by manual labor. This was a slow, costly operation and was replaced by flushing with water.

At the present time, starch tabling has been replaced by centrifugal separation. Merco centrifuges are used, which operate in principle like cream separators. The lighter protein particles flow out the center and the heavier starch particles at the periphery. A more recent development is the use of hydrocyclones or Dorr Clones in this separation step. This has been described by Vegter (2,3,4). Vortical separation is obtained through use of batteries of small cones. Separation is effective in both instances as starch with a protein content of 0.3–0.4% is obtained.

The starch fraction receives further refining. The gluten fraction is concentrated and dried for use in animal feeds or as a raw material for the production of the purified protein, zein.

Starch Washing

The purified starch from the centrifugal separation step is washed with water several times to remove soluble materials. String discharge vacuum filters are normally used. Work has been done on use of hydrocyclones for this step and some are in use.

At this stage the major objective of corn refining has been achieved, namely, obtaining a pure starch containing a minimum amount of protein and other impurities. The starch may be dried to make commercial corn starch or may receive additional treatments to make special or modified starches.

Starch Drying

The purified starch slurry is dewatered by use of vacuum filters or dewatering centrifuges to a moisture range of 32-45% and dried. Apron and flash dryers are normally employed, but vacuum dryers are used in a few instances, as are kilns and spray dryers.

Improvements in this area have been directed toward greater efficiencies and better control of starch properties. The most recent development has been use of the flash dryer which uses a stream of combustion gases. Moisture removal is rapid and changes in properties of the starch are minimized.

The dried starch is available in powdered, pearl, pebble, and granulated forms. Type depends upon desires of users. It is usually packaged in 100 lb. units, although in some instances it is handled in bulk.

Further Steps

The basic corn-refining steps might be considered completed after starch drying. However, manufacturing is carried much further, using the purified starch either before or after drying as a raw material for production of corn syrups, corn sugars, special or modified starches, and dextrins. The manufacture of these items is interesting and complex. They account for a large portion of the total products sold and offer many opportunities for product and use development. Applications are diversified: paper, adhesives, textiles, ore purification, oil well drilling, pharmaceuticals, leather tanning, and practically all segments of the food industry.

Literature Cited

1. Cox, Mary J., MacMasters, Majel M., and Hilbert, G. E. *Cereal Chem. 21:* 447 (1944).
2. Vegter, H. J. U.S. Patent 2,689,810 (1954).
3. Vegter, H. J. U.S. Patent 2,754,968 (1956).
4. Vegter, H. J. U.S. Patent 2,778,752 (1957).
5. Watson, S. A., and Hirata, Y. *Cereal Chem. 31:* 423 (1954).
6. Watson, S. A., Hirata, Y., and Williams, C. B. *Cereal Chem. 32:* 382 (1955).
7. Watson, S. A., Williams, C. B., and Wakely, R. D. *Cereal Chem. 28:* 105 (1951).

AN INTERIM COMMITTEE REPORT ON

Flour Specifications and Approved Methods

EDITOR'S NOTE: *This paper constitutes a report of the Association's Technical Committee on Flour Specifications and Approved Methods. It has been prepared by the members of the Committee who, with George Garnatz, before his untimely death, devoted much of their time and effort to bring agreement on flour specification factors that were considered pertinent to the purchase and sale of flour for bread production. This interim report is presented so that members of the Association may have the benefit of the collective thinking of the Committee on a subject which has many uncertainties and ramifications.*

Committee members include James Doty, John Whinery, L. L. Warren, Oscar Skovholt, L. F. Marnett, S. N. White, R. W. Mitchell, H. J. Steinbrecher, Gaston Dalby, W. H. Ziemke, Betty Sullivan, F. D. Schmalz, and William H. Cathcart. George Garnatz and Wendell Reeder were members of the Committee for several years.

WHEAT, BEING A biological material, can be expected to be variable. Because it is variable, flour having different properties can be manufactured from it to meet the demands of the baker. Also because of the variable properties inherent in the raw materials, cereal chemists have devoted much effort to devising ways to express the quality characteristics of flour. This effort has resulted in many methods of analysis, finding acceptance and being incorporated into flour specifications used by the traders of flour.

Such success, however, created other problems that require solution. In some respects, the problems of the buyer and seller of flour become intensified from the many different ways a given flour quality characteristic can be expressed. A pyramid of specifications, some not significant, have found their way to flour sales contracts. Now, a need has developed for a definition of the pertinent flour specification factors and an agreement on the methods that should be used to determine and express these factors.

The subject of flour specifications has always been of concern to the cereal chemist, for he is responsible for quality control and uniformity. He has been aware that not only must he have adequate methods to determine the quality characteristics of flour, but he must use terminology and analytical figures that are understood by all who trade in flour. Lack of agreement as to what quality factors are important or how they should be expressed creates doubts in the minds of the buyer and the seller of flour. Such doubts or misunderstandings detract from the importance and the responsibility that the cereal chemist is expected to assume as a member of a management team.

The purpose of this communication is to summarize the collective thinking of members of the Flour Specifications Committee, Certain agreements have been reached through deliberations of the Committee which should prove of value in giving direction to those who buy and sell flour. There are, of course, areas which still require study and further research before certain pertinent quality factors can be adequately expressed.

Garnatz (3), in 1951, envisioned the American Association of Cereal Chemists assuming leadership in bringing understanding on the matter of flour specifications. In speaking to a group of cereal chemists Garnatz said "This paper is an attempt to define the challenge that flour specifications bring to cereal chemists. Individually and in Association activities it is hoped that it will be accepted and that cereal chemists will marshal their abilities and facilities so that they may organize to channel collaborative effort along lines to bring order out of chaos."

In order to implement study of flour specifications, a workshop was organized by members of the Association and held in Chicago during December 1952. These deliberations, summarized in four papers by Cathcart (1), Whinery (5), Clark (2), and Sullivan (4), emphasized the great need for agreement on what methods should be recommended for determination and expression of flour characteristics as demanded in flour specifications. The workshop provided an opportunity for many cereal chemists to focus attention on a subject which Mr. Garnatz had called to their attention several years earlier. In May of 1953, President R. A. Barackman appointed a committee, headed by Mr. Garnatz, to summarize the results of the flour specifications workshop. This committee, in 1954, under the Technical Policy Committee organization, became known as the Flour Specifications and Approved Methods Committee. In 1955, the Committee membership was enlarged to 16 members, including representatives from the major mills and bakeries in the United States. Each year, up to March 1958, the Committee met to deliberate and make decisions. The last meeting was held on March 7, 1958.

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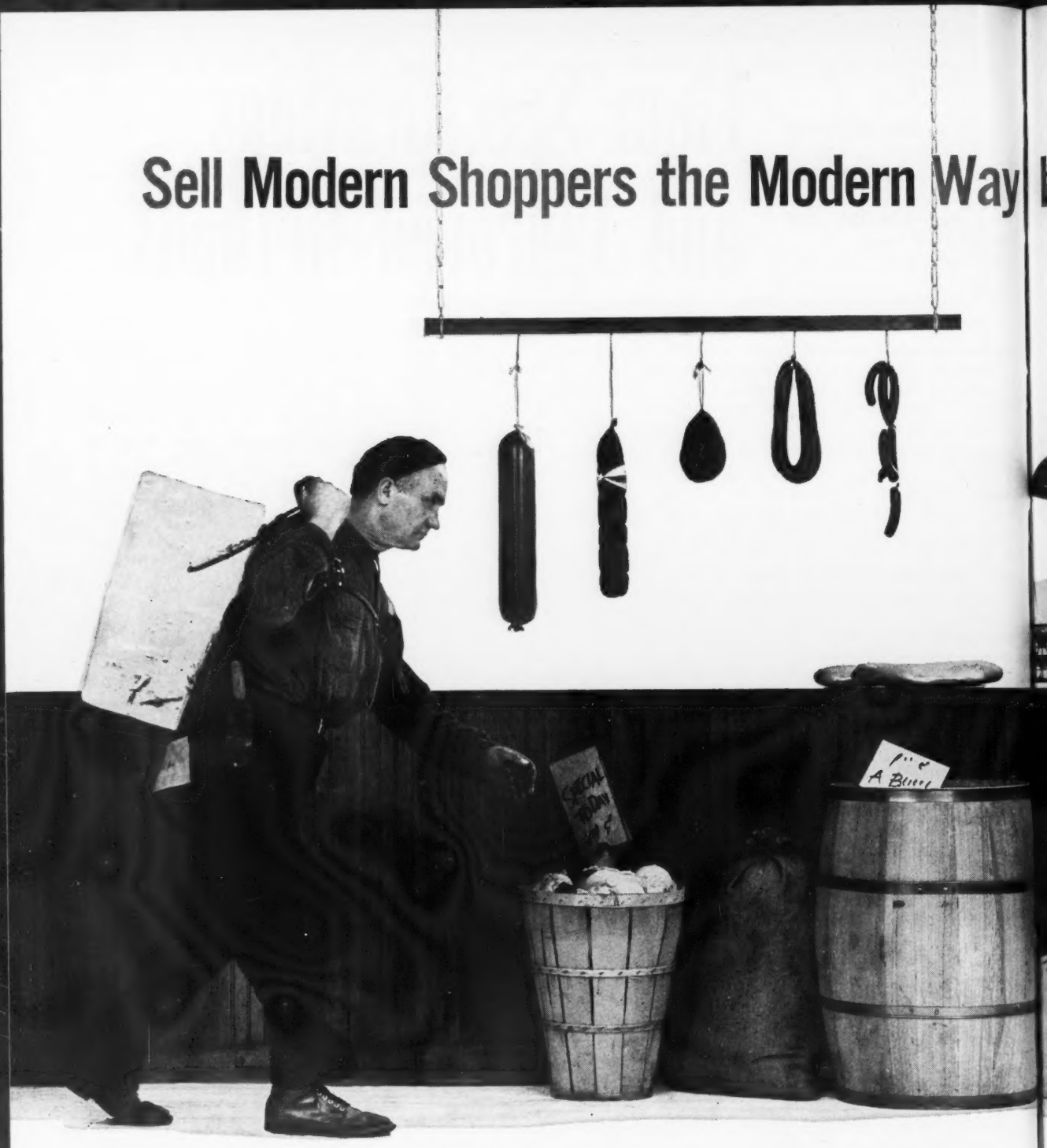

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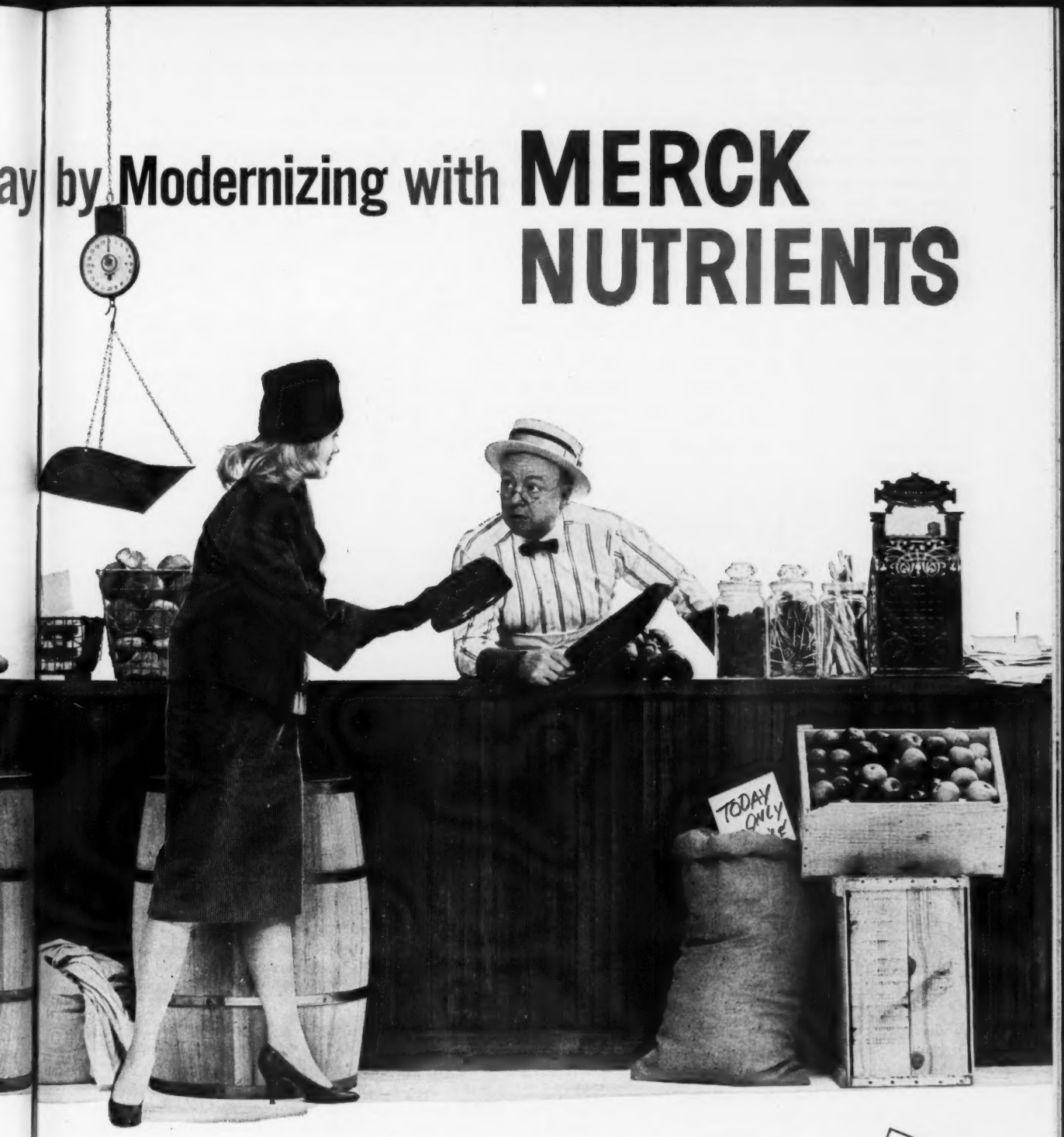

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The Committee on Flour Specifications and Approved Methods, in 1956, formulated the objectives that were to be followed during the ensuing years. These objectives were as follows:

1) Prepare a list of pertinent factors for flour specifications for white pan bread flour.
2) Prepare a list of the methods that should be used for measuring these flour specifications.
3) Establish a degree of confidence in analytical figures used to express flour specifications.
4) Establish continuity in the work of the Flour Specifications and Approved Methods Committee.

The first two objectives have been attained to a certain degree. In the words of the former chairman, "We have gone as far as available methods and techniques permit. We have arrived at an agreement of the pertinent factors that might be included in flour specifications. Not all pertinent factors may be adequately measured, and there continues to be a need for research on methodology."

The Committee on Flour Specifications and Approved Methods presents the following recommendations for factors pertinent to flour specifications for white pan bread and for methods by which these factors may be measured and expressed:

Moisture. Method 48.3a, p. 218 or 223, *Cereal Laboratory Methods* (6th ed.).

Protein Content. Method 67.1, p. 293, *Cereal Laboratory Methods* (6th ed.). Percent nitrogen shall be multiplied by factor 5.7 and expressed on a 14% moisture basis.

Ash Content. Method 9.1a or 9.1b, pp. 38-39, *Cereal Laboratory Methods* (6th ed.). Ash content shall be expressed on a 14% moisture basis.

Diastatic Activity. Two methods of expression have been agreed upon. Method 34.1, p. 178 (pressuremeter method) and Method 8.2, p. 36-37 (hot paste viscosity), *Cereal Laboratory Methods* (6th ed.). Results of Method 34.1 are expressed as mm. of mercury pressure after 5 hours of fermentation. Method 8.2 is expressed to the nearest five units, as the maximum viscosity in Brabender units.

Absorption. Method 26.4, pp. 132-136, using (1) Constant Flour Weight Procedure, *Cereal Laboratory Methods* (6th ed.). Absorption is reckoned as percent of the flour weight expressed on a 14% moisture basis.

Mixing Characteristics. Method 26.4, pp. 132-136, using (1) Constant Flour Weight Procedure, *Cereal Laboratory Methods* (6th ed.). From the farinograph curve, (1) dough development time and (2) tolerance index may be measured and expressed as indicated on p. 138, *Cereal Laboratory Methods* (6th ed.).

Color. Method 20.4, p. 102, *Cereal Laboratory Methods* (6th ed.). It was recognized that the Pekar Color Test does not lend itself to quantitative expression. A need exists for a method which would express the color of flour in definite analytical values. Until such a method is available, color cannot meet a flour specification and be defined except in the very broadest of terms.

Bread-baking Properties. Two optional methods are recognized. Method 11.2b, pp. 50-54, and Method 11.2c, pp. 55-56, *Cereal Laboratory Methods* (6th ed.).

Oxidation. While oxidation is considered pertinent to flour specification, it is a broad term which embodies a maturing agent treatment of the flour, natural aging, chemical oxidants, and other factors. The Committee found no tests other than the baking tests to yield results which could be called objective. Even with the baking tests, difficulty is experienced in "quantitizing" so so as to lend a value which is meaningful in flour specifications.

Extraneous organisms. It is recognized that flour may vary to a considerable extent in bacteria and mold count. Knowledge is lacking as to whether these extraneous organisms have any effect on flour quality. It is generally assumed that flour carrying a large number of *Bacillus mesentericus* is undesirable, since spores from these organisms may survive the baking process, and that an excessive number of certain mold spores is also undesirable because they impart certain objectionable flavors and odors to bread. It is suggested that flour specifications carry a statement to the effect that flour must be clean, wholesome, and free of excess extraneous materials.

Likewise, the importance of insect and rodent contamination was considered as a pertinent consideration in flavor specifications. Since all flours entering commerce are subject to the regulations of the Pure Food and Drug Act, no recommendation regarding this factor was made by the Flour Specifications Committee.

The Committee on Flour Specifications recognized the need to establish the standard error for the determinations that are used to measure and express flour specifications, and suggested that the standard errors of single determination for several of the common laboratory determinations be used as a guide. (Listed in Section 29.0, p. 145, *Cereal Laboratory Methods.*) It was recognized also that a policy should be established as to what constitutes a reasonable error between laboratories and what should be the least significant difference in analytical values that would be of concern in flour specifications. Since certain information concerning these problems was lacking, the Committee did not make any recommendations. Perhaps information will be forthcoming through the various technical committees.

Considerable thought was given to the desirability of adopting a uniform reporting form to be used with flour specification. After thoroughly discussing the problem, the Committee abandoned the idea of uniform reporting forms.

The Committee has recommended that a new Flour Specifications Committee be appointed every three years with responsibility to evaluate new techniques as they become available through research.

(Please turn to page 258)

AACC Pesticide Residue Committee: Report for 1960

E. E. Chapman, H. L. Marks, J. F. Wintermantel, and Warren O. Edmonds, Chairman

EDITOR'S NOTE: *The AACC Pesticide Residue Committee has recommended in its annual report that the present pesticide residue methods in* Cereal Laboratory Methods, *6th edition, be discontinued; and that the following three methods be presented for "First Approval" for the 7th edition.*

Hereby recommended for First Approval are: (1) Determination of Residual Hydrocyanic Acid in Commodities; (2) Colorimetric Method for the Determination of Malathion in Milled Wheat Products; and (3) A Method for the Determination of Inorganic Bromide Residues in Grain and Cereal Products.

The methods were developed by the American Cyanamid Company, who have kindly granted permission for their use by the AACC in Cereal Laboratory Methods.

Copyright (1955) on the material, published in Analysis of Insecticides and Acaricides, *is held by Interscience Publishers, Inc., 250 Fifth Ave., New York 1, N.Y., who have kindly given permission to reproduce it in* Cereal Laboratory Methods *and in the present preliminary form.*

DETERMINATION OF RESIDUAL HYDROCYANIC ACID IN COMMODITIES

(For First Approval)

Principle: The method is based on the evolution of HCN from the sample by distillation from an acid solution. The HCN is absorbed in an excess of alkali and titrated with standard $AgNO_3$. The procedure is applicable to grains and dried foods in general.

In explanation of the method, it might be said that the silver nitrate titration depends on the formation of the soluble silver cyanide-sodium cyanide complex AgCN·NaCN. When to the distillate containing the cyanide and excess caustic, just sufficient silver nitrate is added for the formation of this complex, according to the equation

$$2NaCN + AgNO_3 \; AgCN \cdot NaCN + NaNO_3,$$

the liquid will remain clear. When a very minute quantity of silver nitrate in excess over the required amount is added, a slight turbidity appears, which is due to the insoluble silver cyanide (or in the presence of potassium iodide, due to the formation of the more insoluble silver iodide). The turbidity can best be observed against a dark background, with light coming from the side. Its appearance indicates the end point of the titration.

Please note from the equation that one molecular fraction of silver nitrate is equivalent to two of sodium cyanide, a matter which is taken into consideration in the method of calculation indicated where N $AgNO_3$ is the normality of the silver nitrate.

Apparatus: (1) Steam generator. A 2-liter round-bottom flask, fitted with a 2-hole rubber stopper which carries a 30-in. glass safety tube extending to the bottom of the flask, and a short piece of glass tubing with a right-angle bend for steam delivery. The flask is heated by means of a Meeker burner.

(2) Distillation flask. A 2-liter round-bottom flask, fitted with a 2-hole rubber stopper carrying a steam inlet tube, which extends to the bottom of the flask, and a distillation trap or scrubber (a Kjeldahl) connecting bulb. Fisher Scientific Co. Cat. No. 13-187 is suitable.

(3) Condenser, 16-in. water-cooled, with adapter to extend below the surface of the receiving liquid. A loose pledget of Pyrex wool in the adapter will prevent certain solids carried over during distillation from entering the receiver.

(4) Beaker, 600-ml. tall-form (distillate receiver).

(5) Microburet, 10-ml.

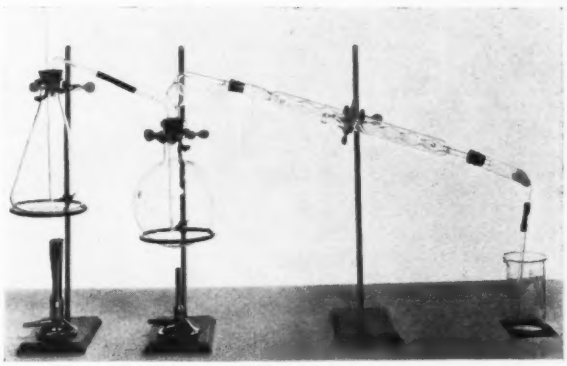

Fig. 1. Apparatus for determining residual hydrocyanic acid.

Reagents: (1) Sodium hydroxide, 2.5% aqueous solution.

(2) Silver nitrate, standard 0.02N solution.

(3) Soda-lead mixture. Dissolve separately 200 g. of c.p. sodium carbonate and 20 g. of lead acetate in water, mix the solutions, dilute to 1 liter. Shake before using.

(4) Tartaric acid, 10% aqueous solution.

(5) Potassium iodide, 2% aqueous solution.

(6) Ammonium hydroxide, concentrated reagent.

Procedure: Assemble the distillation apparatus, with the distillation trap attached to the condenser, and the adapter extending below the surface of 50 ml. of 2.5% NaOH in the receiving beaker (600 mL).

Weigh 50–100 g. of sample (25 g. flour), and transfer to the distillation flask, which contains about 250 ml. of water. Add 50 ml. of 10% tartaric acid, and immediately insert the stopper in the flask. With rubber tubing, connect the outlet tube of the steam generator to the steam inlet tube of the distillation flask, and pass steam through the sample solution until 400–500 ml. of distillate have been collected. Remove the receiver, then disconnect the rubber tubing from the steam generator.

Add 5 ml. of soda-lead mixture to the distillate. If a dark precipitate of lead sulfide appears, filter through a Gooch crucible containing an asbestos mat; wash the beaker and precipitate with a small amount of water. If no sulfide is present, the filtration is not necessary. Add 10 ml. of concentrated NH_4OH and 10 ml. of 2% KI to the solution, and titrate with 0.02N $AgNO_3$. The end point is a faint permanent turbidity, which can be seen easily against a black background.

Carry through a blank determination on the same weight of a control sample of the material which has not been treated with HCN.

Calculation:

$$\text{Cyanide as ppm HCN} = \frac{(A - B) \times N \; AgNO_3 \times 5.4 \times 10^4}{\text{sample weight}}$$

where A = ml $AgNO_3$ required by treated sample;
B = ml $AgNO_3$ required by untreated sample.

Acknowledgments: Printed with the permission of American Cyanamid Co., Agricultural Division, New York 20, New York.

Reference: Association of Official Agricultural Chemists. Official and tentative methods of analysis (8th ed.), Secs. 22.55, 22.56, p. 380. The Society: Washington, D.C. (1955).

COLORIMETRIC METHOD FOR THE DETERMINATION OF MALATHION IN MILLED WHEAT PRODUCTS

(First Approval)

Principle of the Method: The malathion, S-(1,2-dicarbethoxyethyl)-0,0-dimethyl dithiophosphate, is removed from the finely divided sample by extraction with carbon tetrachloride. The malathion in the carbon tetrachloride extract is decomposed by addition of ethanol and sodium hydroxide into sodium, 0,0-dimethyl dithiophosphate, sodium fumarate, and ethanol. The sodium 0,0-dimethyl dithiophosphate is then converted to the cupric salt which is soluble in carbon tetrachloride with the formation of an intense yellow color. The color intensity is proportional to the concentration of 0,0-dimethyl dithiophosphoric acid and is measured colorimetrically at 418 mμ, the absorption peak. The corresponding amount of insecticide is then ascertained by comparison with a calibration curve prepared from known amounts of pure insecticide carried through a similar procedure.

The method described has been used satisfactorily to determine added amounts of malathion in milled wheat products, namely wheat, flour, bran, shorts, etc., in the range of 0.2–2.0 ppm.

Special Apparatus: (1) Klett-Summerson photoelectric colorimeter (or equivalent) equipped with cells having 4 cm. effective light path and filter giving maximum transmittance in the range of 418 mμ.

Reagents: (1) Malathion. Purified material, obtainable from American Cyanamid Co., Stamford, Conn.
(2) Carbon tetrachloride, ACS reagent grade (see Note 1).
(3) Ethyl alcohol, absolute or Formula 2-B (anhydrous) (see Note 2).
(4) Carbon disulfide solution. Dissolve 1 ml. c.p. carbon disulfide in 100 ml. of ACS reagent grade carbon tetrachloride.
(5) Sodium hydroxide solution, aqueous, 6*N* (approx.).
(6) Sodium sulfate solution. Dissolve 90 g. c.p. Na_2SO_4 in distilled water and dilute to 1 liter with water.
(7) Copper sulfate solution. Dissolve 3.5 g. of c.p. $CuSO_4 \cdot 5H_2O$ in 100 ml. of distilled water.
(8) Hydrochloric acid, aqueous, 6*N* (approx.), and aqueous, 1*N* (approx.).
(9) Phenolphthalein indicator, 1%, in ethyl alcohol.

Preparation of Calibration Curve for Malathion: Dissolve approximately 62.5 mg. (weighed to 0.1 mg.) of pure malathion in ethyl alcohol and dilute volumetrically to 250 ml. with ethyl alcohol. Mix well, then transfer a 10-ml. aliquot to a 250-ml. volumetric flask and dilute to volume with ethyl alcohol. (1 ml. = 10 micrograms of malathion.) Using this standard solution, carry aliquots of 0, 4, 8, 12, 16, 20, and 24 ml. through the following procedure.

Transfer the aliquot to a 500-ml. separatory funnel containing 200 ml. of CCl_4 and 1 ml. of the carbon disulfide solution (see Note 3), and add ethyl alcohol until the total volume of alcohol present is 50 ml.; then mix by gentle swirling. Add 150 ml. of the sodium sulfate solution and 5 ml. of conc. HCl and shake vigorously for 1 minute. Allow the layers to separate and filter the CCl_4 layer through a fluted filter paper into a dry 500-ml. separatory funnel. Do not allow any of the aqueous layer to run into the filter paper and do not wash the paper. Add 50 ml. of ethyl alcohol to the separatory funnel containing the filtered CCl_4 solution of malathion and mix by swirling. Add 2 ml. of 6*N* NaOH and shake for exactly 1 minute (see Notes 4 and 5). Immediately add 150 ml. of the sodium sulfate solution (cooled to about 10°C.) and shake vigorously for 1 minute. Allow the phases to separate, then draw off the CCl_4 layer and discard it. Add 50 ml. of CCl_4 to the separatory funnel, shake vigorously for 30 seconds, allow phases to separate, and discard CCl_4 layer. Add to the separatory funnel 50 ml. of CCl_4 and one drop of phenolphthalein solution, and add 6*N* hydrochloric acid dropwise with swirling until the pink color disappears, then add 2 ml. of 1*N* hydrochloric acid. Shake vigorously for 30 seconds, allow phases to separate, and discard CCl_4 layer. Again add 50 ml. of CCl_4, shake vigorously for 30 seconds, allow phases to separate, and discard CCl_4 layer. Repeat the extraction of the aqueous layer a third time with 50 ml. of CCl_4, allow layers to separate, and draw off the CCl_4 layer as completely as possible and discard it. Using a buret, add exactly 30 ml. of CCl_4 (see Note 6) and 2 ml. of the copper sulfate solution, shake vigorously for 1 minute, and allow layers to separate. Immediately filter the CCl_4 layer through a small plug of cotton placed loosely in a funnel into a cell having an effective light path of 4 cm. Measure the absorbance of the yellow color (see Note 7) at 418 mμ. Use ACS reagent grade CCl_4 as the reference solution. Prepare a calibration curve by plotting the absorbance of each of the aliquots against micrograms of malathion present.

Procedure for Determination of Malathion in Milled Wheat Products: (1) Extraction of Malathion from Sample. Transfer a 500-g. sample of ground wheat or flour, or a 250-g. sample of shorts or bran, to a 1-gal. wide-mouth bottle. Add 1,000 ml. of CCl_4, place a tinfoil-lined plastic cap tightly on bottle, and agitate for 4 hours on the rolls. Remove and immediately filter slurry with the aid of vacuum through a Büchner funnel containing a filter paper disk into a large filtering flask. Transfer a 400-ml. aliquot (representing a 200- to 100-g. sample) of the filtered CCl_4 extract to a 600-ml. beaker and concentrate to a volume of about 175 ml. by evaporation on the steam bath with the aid of a jet of air passing across the surface. Reserve the concentrated extract for malathion analysis.

(2) *Determination of Malathion in CCl_4 Extracts.* Transfer the concentrated CCl_4 extract of the sample to a 500-ml. separatory funnel, add 1 ml. of the carbon disulfide solution, and then CCl_4 until the total volume of solution in the funnel is 200 ml. Add 50 ml. of ethyl alcohol and mix by swirling. Add 150 ml. of sodium sulfate solution and 5 ml. of conc. HCl and shake vigorously for 1 minute (see Note 9). Allow the layers to separate and filter the CCl_4 layer through a fluted paper into a dry 500-ml. separatory funnel. Do not allow any of the aqueous layer to run into the filter paper and do not attempt to wash the paper. Add 50 ml. of ethyl alcohol to the separatory funnel containing the filtered CCl_4 solution and mix by swirling. Add 2 ml. of 6*N* NaOH and shake for exactly 1 minute (see Notes 4 and 5). Immediately add 150 ml. of sodium sulfate solution (cooled to about 10°C.) and shake vigorously for 1 minute. Allow the phases to separate, then draw off the CCl_4 layer including the small amount of suspended solids which are usually found at the aqueous-CCl_4 interface, and discard it. Add 50 ml. of CCl_4 to the separatory funnel, shake vigorously for 30 seconds, allow phases to separate, and discard CCl_4 layer. Add 50 ml. of CCl_4, and 1 drop of phenolphthalein solution, and add 6*N* hydrochloric acid dropwise with swirling until the pink color disappears; then add 2 ml. of 1*N* hydrochloric acid. Shake vigorously for 30 seconds, allow phases to separate, and discard CCl_4 layer. Again add 50 ml. of CCl_4, shake vigorously for 30 seconds, allow phases to separate, and discard CCl_4 layer. Repeat the extraction of the aqueous layer a third time with 50 ml. of CCl_4, allow layers to separate, and draw off CCl_4 layer as completely as possible and discard it (see Note 8). Using a buret add exactly 30 ml. of CCl_4 (see Note 6) and 2 ml. of the copper sulfate solution, shake vigorously for 1 minute, and allow layers to separate. Immediately filter the CCl_4 layer through a small plug of cotton placed loosely in a funnel into a cell having an effective light path of 4 cm. Measure the absorbance of the yellow color (see Note 7) immediately at 418 mμ. Use ACS reagent grade CCl_4 as the reference solution. From the calibration curve prepared similarly, read the amount of malathion corresponding to the absorbance observed, and calculate to ppm malathion in the sample.

Calculations:

$$\text{ppm malathion in sample} = \frac{\text{micrograms malathion found}}{\text{g. sample in aliquot analyzed}}$$

NOTES ON PROCEDURE: (1) ACS reagent grade carbon tetrachloride is recommended for use throughout this procedure. Presumably other grades of similar purity may be used satisfactorily. Technical grade carbon tetrachloride after distillation from glass apparatus has been found satisfactory. However, owing to possible variation in impurities between different lots, distilled technical grade carbon tetrachloride cannot be recommended without extensive preliminary testing. If a large number of analyses are contemplated, it may be advantageous to use technical carbon tetrachloride (without distillation) for the initial extraction of the malathion from the sample, provided this carbon tetrachloride passes the following test: Evaporate 400 ml. of the carbon tetrachloride to about 175-ml. volume on the steam bath with the aid of a jet of air passing across the surface. Add a known amount of malathion (approx. 50 γ) in ethanol and analyze the solution for malathion, using ACS reagent grade carbon

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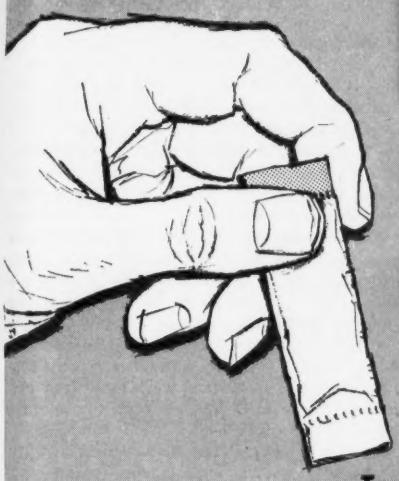

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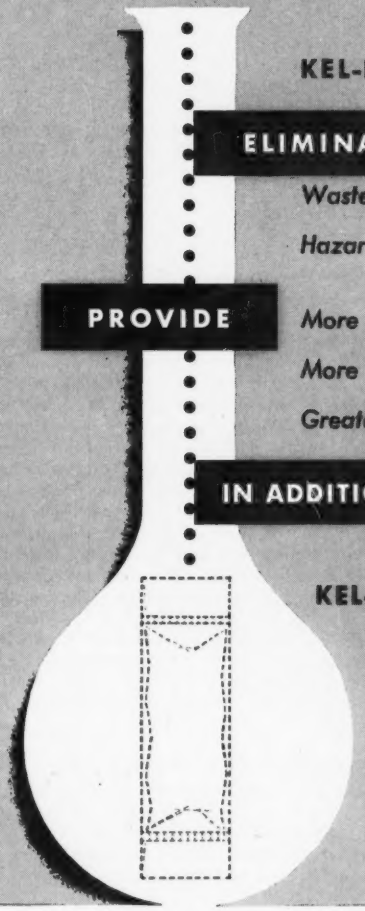

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#2 10 grams K_2SO_4; .3 gram $CuSO_4$*
#3 9 grams K_2SO_4; .35 gram H_gO*
#4 10 grams K_2SO_4; .7 gram H_gO*
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tetrachloride and the procedure described for the preparation of the calibration curve. Use the calibration curve which has been prepared, using ACS reagent grade carbon tetrachloride to calculate the amount of malathion recovered, and if the recovery checks the amount added within ±10%, the carbon tetrachloride should be satisfactory.

(2) It is essential that the ethyl alcohol contain not more than approximately 0.5% water, since larger amounts will produce low results.

(3) The exact function of the carbon disulfide in this procedure has not been determined. Carbon disulfide reacts with the ethyl alcohol and the sodium hydroxide in the alkali decomposition step to form sodium xanthate. It is believed that the xanthate then acts as an antioxidant to prevent atmospheric oxidation of the dimethyl dithiophosphoric acid formed in the procedure, and/or that it forms complexes with trace metals (possibly copper) present in the reagents or sample and thus prevents their interference.

(4) The procedure from this point on should be carried out without interruption. Aqueous alkaline and acid solutions of dimethyl dithiophosphoric acid are stable for short periods only.

(5) Conditions required to produce maximum decomposition of the insecticide by alkali to dimethyl dithiophosphoric acid are critical. Reaction periods of less than 30 seconds and more than 2 minutes produce low results.

(6) If apparatus is not available for measuring the absorbance of color in cells having 4 cm. effective light path, the amount of CCl_4 used for extraction of the color may be reduced to 10 ml. and a 1-cm. cell may be used. However, the precision and sensitivity of the method will be decreased.

(7) The yellow color of the copper dimethyl dithiophosphate complex in CCl_4 is usually not stable for more than a few minutes, so that the color should be measured within 2 to 3 minutes after extraction if possible.

(8) The CCl_4 layer at this point should be completely colorless. Prove absence of color by measuring absorbance at 418 mμ. If not colorless, continue extraction with CCl_4 until the extract is colorless. Extracting of the acidified aqueous solution removes interfering colored substances originally present in the sample and also removes the xanthate formed from the carbon disulfide which has been added previously. Xanthate, if not completely removed, will react later with the copper reagent to form a complex which is extracted into CCl_4 with the formation of a very unstable yellow color.

(9) The purpose of this acidic aqueous wash is to remove substances which tend to form slow-breaking emulsions at points later in the procedure where length of standing time is more critical.

Acknowledgments: Printed with the permission of American Cyanamid Co., Agricultural Division, New York 20, New York.

References: (1) Norris, M. V., Vail, W. A., and Averell, P. R. Colorimetric estimation of malathion residues. *J. Agr. Food Chem. 2:* 570 (1954).
(2) Gunther, F. A., and Blinn, R. C. Analysis of Insecticides and Acaricides, Vol. 6, p. 475 (1955).

A METHOD FOR THE DETERMINATION OF INORGANIC BROMIDE RESIDUES IN GRAIN AND CEREAL PRODUCTS
(First Approval)

General Description of Method: Inorganic bromide residue is determined on the sample after extraction of the organic bromide with methylene chloride. Organic bromide may be determined by analyzing the total bromide and inorganic bromide and subtracting the titers of the inorganic from the total.

Apparatus: (1) Nickel crucible, 100-ml. capacity.
(2) Muffle furnace. Any type that will maintain 600°C. will do.

Reagents: (1) Potassium hydroxide, 2.5% solution in ethyl alcohol.
(2) Sodium hydroxide pellets.
(3) Sodium peroxide.
(4) Hydrochloric acid, 6*N* solution which should be as free of bromides as possible. Concentrated acid is diluted to 6*N* and distilled, the first and last 10% fractions being discarded to eliminate most of any free bromine or hydrobromic acid.
(5) Sodium hydroxide, 3*N* solution.
(6) Sodium acid phosphate.
(7) Hypochlorite solution, 1*N*, in 0.1*N* sodium hydroxide solution.
(8) Sodium formate, 50% solution.
(9) Sodium molybdate, 1% solution.
(10) Potassium iodide.
(11) Sulfuric acid, 6*N* solution.
(12) Sodium thiosulfate, 0.01*N* solution. Stabilize with 1 g. of sodium carbonate per 1,000 ml. Standardize against 0.01*N* potassium iodate solution in the presence of 75 ml. of water, 10 ml. of 6*N* sulfuric acid solution, and 0.5 g. of potassium iodide per aliquot of thiosulfate solution being titrated.
(13) Starch indicator, 1% solution. Mix about 2 g. of finely powdered potato starch with cold water to thin paste, add about 200 ml. of boiling water, stirring constantly, and immediately discontinue heating. Add 1 ml. of mercury, shake, and allow the starch solution to stand over the mercury.
(14) Methylene chloride. Commercial material usually contains a trace of hydrolyzable bromide which is removed by shaking 2,000 ml. of this solvent with 15 g. of potassium hydroxide dissolved in 300 ml. of 95% ethyl alcohol and allowing the mixture to stand for several days. The alcoholic potassium hydroxide solution is then washed out with water and the methylene chloride is filtered, dried over anhydrous calcium sulfate, and fractionated.

Procedure: Total bromide. To a sample weighing 5 to 10 g. in the nickel crucible add 40 ml. of alcoholic potassium hydroxide solution with stirring. Allow the mixture to stand for 1 hour, then evaporate it to dryness on a steam bath. After further drying for a short time at 110°C., cover it with 10 g. of sodium hydroxide pellets. Place the crucible for 1 to 2 hours on a hot plate until the bubbling or smoking diminishes; then place it in a muffle furnace at 600°C. (Note 1). Add sodium peroxide to the melt, a few mg. at a time, to complete the oxidation of the remaining organic matter. The peroxide must be added cautiously while the crucible is removed from the furnace; bromide is lost if the charge burns with a flare when too much peroxide is added at one time (Note 2).

Rotate the crucible to allow the melt to solidify on the sides, cool and dissolve contents in 75 ml. of water (Note 3). Transfer the resulting solution to a 400-ml. beaker and partially neutralize with about 50 ml. of 6*N* hydrochloric acid solution, then boil to destroy peroxides and to reduce the volume to about 100 ml. Remove nickel hydroxide and other insoluble hydroxides by filtering through a No. 2 Whatman paper, collecting the filtrate and washings in a 500-ml. wide-mouthed Erlenmeyer flask. Make the filtrate slightly acid with 6*N* hydrochloric acid solution, then neutralize with sodium hydroxide solution, adjusting to the color change of methyl red. The volume at this point should be approximately 150 ml.

Add about 2 g. of sodium acid phosphate and 5 ml. of hypochlorite solution and heat the mixture to boiling. After a minute or so, introduce 5 ml. of the sodium formate solution and continue boiling for 2 minutes. Cool the sample and treat with a few drops of 1% sodium molybdate solution, 0.5 g. of potassium iodide, and 25 ml. of 6*N* sulfuric acid solution. Titration should be made immediately with standard 0.01*N* sodium thiosulfate solution, adding starch indicator just before the end point. A blank on all the reagents should be carried through the entire procedure.

Separation of organic bromide. Triturate a replicate sample of 5 to 10 g. in a 100-ml. beaker with 15 ml. of methylene chloride, and filter immediately through a fritted-glass crucible, rinsing with three 5-ml. portions of solvent (Note 4). Transfer most of the filter cake back to the beaker and allow to stand for 5 minutes with 15 ml. additional of methylene chloride (Note 5), then filter and rinse as before. Again return the solid to the beaker and treat with 15 ml. of methylene chloride, this time for a 15-minute period, followed by a third filtration and rinsing in the same crucible (Note 6).

Inorganic bromide. Inorganic bromide may now be determined on this extracted filter cake by the same procedure as described for total bromide, practically all the organic bromide having been removed (Note 7) by the extraction with methylene chloride.

Notes: (1) Fusion should be carried out without excessive burning or foaming; if the charge becomes ignited, remove the

crucible from the muffle until the flame is extinguished; then return it to the muffle and repeat this process until the volatile gases have been removed.

(2) Complete combusion of the organic matter can be effected best by returning any organic matter that has risen above the sodium hydroxide to the bottom of the crucible, where it mixes with the melt and is easily destroyed by addition of the peroxide. This is accomplished by carefully rotating the hot crucible to wash down the organic matter and adding 0.5 g. more of peroxide. If no burning or bubbling takes place, the oxidation is complete. A few carbon particles which may remain after the final addition of sodium peroxide do not affect the accuracy of the results.

(3) Solution of the sodium compounds is hastened by placing the crucible on a hot plate for several minutes.

(4) In filtering by suction, the sample should not be allowed to become so cold from evaporation that moisture condenses on it.

(5) If the filter cake is lumpy it should be ground with the solvent in a mortar at this stage.

(6) The filtrate, which is ordinarily discarded, contains most of any methyl bromide or other soluble organic bromide, but not all, since the extraction may have been incomplete and since volatile compounds may have escaped. The presence of a soluble bromide compound may, if desired, be detected by catching the filtrates in alcoholic potassium hydroxide and determining the inorganic bromide formed after evaporation to dryness and ashing. Whether or not the bromide so found is methyl bromide or a nonvolatile organic halide may be ascertained by making a duplicate set of extractions and evaporating the extracts to about half their original volume before addition of alcoholic alkali. Methyl bromide is expelled during this process and nonvolatile bromide may be determined on the remainder after hydrolysis and ashing.

To remove any incompletely extracted volatile bromide compounds, return the sample remaining after extraction to the original beaker and treat with 15 ml. of methylene chloride. Evaporate this to dryness while stirring to prevent bumping, but do not over-heat. When the sample appears dry, lay the beaker on its side in a warm place, such as on top of an oven, until all the odor of methylene chloride is gone.

(7) The residue after water extraction may be placed in a 100-ml. nickel crucible and analyzed for bromide in the manner described under total bromide. Generally only a very small fraction of the total bromide will be found in this residue and the amount will be less the more thorough the water washing. Therefore, this bromide is usually considered to be inorganic.

Calculations:

$$\frac{Tx \times 0.1332}{1000\ W} = \text{ppm inorganic bromide,}$$

where Tx = ml. of 0.01*N* sodium thiosulfate used for the titration of the methylene chloride-extracted cake, after organic bromide has been removed; W = grams of sample.

Interferences: Absorbents such as activated charcoal will interfere.

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References:

(1) Shrader, S. A., Beshgetoor, A. W., and Stenger, V. A. Determination of total and inorganic bromide in foods fumigated with methyl bromide. *Ind. Eng. Chem., Anal. Ed. 14:* 1-4 (1942).

(2) Wade, P. Determination of fumigants. XXII. Photometric determination of brominated-hydrocarbon fumigants as inorganic bromide. *J. Sci. Food Agr. 3:* 390 (1952).

IMPORTANT NOTICE—46th ANNUAL MEETING

Members of the AACC wishing to present papers at the 46th Annual Meeting, April 9-13, 1961, in Dallas, should write immediately to the chairman of the session covering their field of interest.

The following sessions have been scheduled: *Pesticide Residues in Cereal Products,* Warren O. Edmonds, American Cyanamid Co., 3125 Gillham Plaza, Kansas City 9, Missouri; *Flavor Research,* Lazare Wiseblatt, American Institute of Baking, 400 E. Ontario St., Chicago 11, Illinois; *Chemistry and Technology of Feed,* Robert C. Wornick, Chas. Pfizer and Co., Inc., Ag Research Dept., Terre Haute, Indiana; *Chemistry and Technology of Yeast,* Gerald Reed, Red Star Yeast and Products Co., 325 N. 27th St., Milwaukee, Wisconsin; *Nutrition Aspects of Feeds,* Max L. Cooley, Hoffman-Taff, Inc., Box 1246 S.S. Station, Springfield, Missouri; *Continuous Breadmaking,* Oscar Skovholt, Quality Bakers of America, 120 W. 42nd St., New York 36, New York; *Starch Chemistry,* R. M. Sandstedt, Dept. Biochemistry and Nutrition, U. of Nebraska, Lincoln 3, Nebraska; *General Session,* Frank R. Schwain, Bulk Food Technical Services, Procter and Gamble Co., Winton Hill Tech. Center, Box 201, Cincinnati 24, Ohio; *Chemistry and Technology of Flour,* Kenneth Gilles, General Mills, Inc., 2010 E. Hennepin Ave., Minneapolis 13, Minnesota; *Useful Laboratory Techniques and Gadgets,* Lawrence L. Warren, Commander Larabee Milling Co., P.O. Box 356, Kansas City 41, Missouri; *Laboratory Layouts,* Grant W. Pearcy, The Pillsbury Company, 224 Second St., S.E., Minneapolis 14, Minnesota.

Byron S. Miller,
Program Chairman, Kansas State University, Manhattan, Kansas.
(Department of Flour and Feed Milling Industries)

THE LAST DATE FOR OFFERING PAPERS FOR PRESENTATION WILL BE DECEMBER 25, 1960

TRAINING COURSE FOR THE FOOD INDUSTRY

Ten Steps for Survival

THE FOOD AND Drug Administration will present a Civil Defense Training Course for the food industry in Dallas, Texas, April, 13-14, 1961, following the AACC annual meeting. This course is sponsored by the Dallas City-County Civil Defense Office, the American Association of Cereal Chemists, Inc., and the Food and Drug Administration, U. S. Department of Health, Education, and Welfare.

The Office of Civil and Defense Mobilization's "Ten Steps for Survival" of industrial plants following disaster will be presented, along with other vital information about how to reduce the vulnerability of food plants to open or secret attack by radiological, biological, or chemical agents. The ten steps are:

1. *Organization and planning for self-protection.* Communications will be given high priority in the presentation of this step.
2 and 3. *Plans for evacuation and provisions for shelters.* Shelters and evacuation of small cadres of key personnel will be stressed.
4. *Plans for continuity of management.* The preparation of a line of succession and a plan of operation during and immediately following disaster are included.
5. *Preservation of vital records and documents.* The problem of how and where to store these records has been well worked out by certain industries and some government agencies. Examples of their solutions will be presented.
6. *Plan for emergency repair and restoration.* This very difficult step will be discussed and suggestions offered for temporary rapid repair of plants and equipment and emergency operations.
7. *Establish a plant security system for the prevention of sabotage and espionage.* This is one of the most important steps in industrial survival. The problems involved will be discussed and partial solution offered. The need is so great in this area of hazard that any effort to remove or reduce the hazards will be helpful in correcting the present critical situation.
8. *Establish industry mutual aid associations for civil defense.* Some of these have already been so well organized and rehearsed that they have been able to effect a considerable saving of lives and equipment under natural disaster conditions. There is every reason to believe they would work satisfactorily under wartime conditions. One or more plans will be explained.
9. *Deconcentrate critical production.* While not as applicable to food production as to heavy industry, it can be applied to certain basic raw materials and containers needed by the food industry. Suggestions for the stockpiling of such materials will be presented.
10. *Disperse new plants.* Dispersal of key industries has long been advocated. Suggestions for such dispersal on a long-time basis will be presented.

Short articles on different subjects to be presented will appear in this and other publications each month until April. Please watch THIS JOURNAL for any announcements pertaining to the FDA Civil Defense Training Course in Dallas.

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- How to organize data for tables
- When to use leader tables
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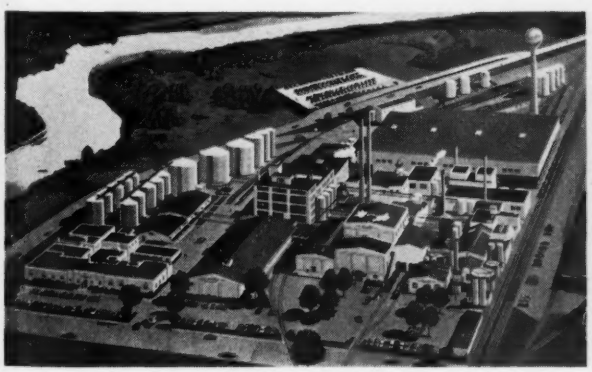

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People, Products, Patter

• • • People

Washington

Melvin R. Ander and **Robert C. Washington** appointed technical sales representatives, Sterwin Chemicals. The former is assigned to Evanston, Ill., office to work under **J. A. Revord;** he has been with Durkee Famous Foods in new product development work. Mr. Washington will work from Kansas City; has been associated with American Bakeries in Dallas as production foreman.

J. A. Anderson, R. A. Bottomley, and **C. W. Brabender** are AACC members who will participate in the program of the cereal chemistry group, 10th annual conference of the Royal Australian Chemical Institute, during October.

Conant

Hopper

Roger E. Conant and **John H. Hopper** join The Kellogg Company's food research group. Dr. Conant, a research veterinarian, will work with the company's biologist on problems which arise in the care and feeding of animals, particularly mink; has been instructor at Iowa State University. Dr. Hopper becomes director of nutrition; formerly head of nutrition section, Armour & Co., Chicago.

Victor J. Evans appointed chief chemist, Fisher Flouring Mills, Seattle, succeeding **Arthur J. King.**

Paul V. Imes appointed technical director, Carey Salt Co., a newly created position, from chief chemist; will work with marketing and production divisions, supervise production, and participate in development of new products.

Fred Robbins and **Anatole Sarko** appointed as project leaders in chemical research area, General Foods Research Center; have been with General Foods since 1958 and 1951 respectively.

Eichar

William G. Eichar promoted to technical sales and service, Chemurgy division of Central Soya Co., handling edible and industrial soya products in the central states. **James L. Liggett** appointed to the company's technical sales and service organization in Chicago, to work with the food trade in application and marketing of CS's edible soya products.

Liggett

Arthur J. King died of a heart attack on July 28 after a short illness.

Mr. King had been with the Fisher Flouring Mills Co. since 1920 and was chief chemist for the past 15 years. He was a charter member and 1939 chairman of the Pacific Northwest Section and served on various AACC committees throughout the years.

Mr. King was a graduate of the University of Washington and spent practically all his life in that state. He is survived by his wife Bernice and two sons, all of Seattle, and by one brother who lives in Alaska.

Loska

Stephen J. Loska has joined the National Dairy Products Corps., Research and Development Division, Glenview, Ill., as Senior Resarch Food Technologist. Loska was formerly with the Research and Development Dept. of the Pillsbury Co., Minneapolis.

Gary R. Zempel appointed equipment development manager for bakery mix division of The Pillsbury Co., a newly created position.

Harvey K. Murer, director of research at the General Foods Research Center in Tarrytown, N.Y., died as a result of an automobile accident Saturday, August 13, at age 49. He was on vacation with his wife, Clarissa, and daughter Karen Ann. He lived in Saddle River, N.J. He is also survived by a Brother, E. B. Murer of St. Louis, Mo.

Mr. Murer joined General Foods Corporation in 1941 in the company's former Central Laboratories. He had been director of research since 1958. He was a graduate of Washington State College and also attended Harvard and Northwestern universities. Prior to joining General Foods, he taught and did research at Washington State and Northwestern ad at the Universtiy of Tennessee.

• • • Products

Chewable vitamins. An amusing and unusual new-product introduction is used by the Fine Chemicals Division of Hoffman-La Roche Inc., to market its Rovicote family of coated B-complex vitamins. The campaign centers around an agency-created, egg-shaped figure of a Chinese gentleman. His name, No Can Chew, is an allusion to that disadvantage of B-complex vitamins – they tasted bad so were not chewable. "No Can Chew" is patterned on an egg-within-an-egg-within-an-egg Chinese toy, to illustrate the fact that Rovicote is a coating, surrounding the tablets, as the outer shell of a "Chinese Egg" surrounds those inside. Promotion kits contain wooden "hen-size" Chinese eggs with paper inserts telling "How Roche Fooled No Can Chew and Made Vitamins Chewable"; also larger Chinese Eggs, and boxes of "fortune cookies" with appropriate announcements.

• • •

All-vegetable emulsifier. A new all-vegetable "mono" ingredient, Atmul® 650, for yeast-raised baked goods, has been developed by Atlas Powder Co.'s Food Industry Department and is now available in commercial quantities. It is said to help bread retain its as-baked, fresh softness while providing finer, more uniform grain, smoother texture, and a tender bite. Its action is due to "cell wall control," a principle brought out by Atlas' Food Laboratories in its earlier bread emulsifier, Atmul® 500,

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Grain moisture meter. A new type of grain moisture meter is described as compact, light, and portable, and easy to operate for measuring the moisture content in grains of all kinds within 2 to 3 minutes. It is guaranteed for accuracy and dependability and can be used anywhere where AC current is available. For full particulars write to Kel Engineering & Equipment Co., P.O. Box 744, New Brunswick, N.J.

• • •

Baking equipment. A 16-page folding pamphlet, available from the Hobart Manufacturing Co., illustrates and describes eight bakery mixers, two food cutters, and three food scales; also shows attachments for chopping, grinding, slicing, shredding, and grating. All mixers have positive mixing action at all speeds and feature Hobart planetary action, in which the beater rotates in the opposite direction to that in which it moves around the bowl. For free copies, write The Hobart Manufacturing Co., Troy, Ohio; or request a copy at any local Hobart sales office.

• • •

Imitation butter flavors. Givaudan Flavors, Inc., has brought out Imitation Butter Emulsion F-3697, with a natural-tasting, creamy and buttery effect in ice cream and sherbet, as demonstrated by the company's Test Kitchen. The flavor may be used alone (2 oz. per 5 gal. of mix) for fresh butter character, or in combination with others (vanilla, chocolate, butterscotch, etc.) for rich creaminess. For a natural butter taste in baked goods Givaudan recommends Imitation Butter Flavor F-2926, 1 to 2 oz. per 100 lb. of batter. Another, Oil-Soluble F-2971, at ½ oz. per 100 lb., "will do wonders in high-fat fillings." Samples are available on request; address the company at 321 W. 44th St., New York 36, N.Y. A request will also bring you a copy of "The Givaudan Flavorist," current issue, which has an index for 1958-1959; some back issues are available.

• • • **Patter**

Flour and feed in Nicaragua. General Mills will join with a Nicaraguan firm, Palazio, Horvilleur & Co., Ltd., to form a new corporation to produce wheat and corn flour and livestock feeds in Nicaragua. Construction is to start this fall on a modern mill at Chinandega, 80 miles northwest of the capital city of Managua. The new plant will be the first commercial milling operation in Nicaraguan history and is expected to process 100 tons of wheat and 40 tons of corn per day. This will be General Mills' third venture in flour production in Latin America, following previous ones in Venezuela and Guatemala.

• • •

Cereal chemistry conference. The cereal chemistry group of the Royal Australian Chemical Institute will hold its tenth annual conference in Leura, near Sydney, New South Wales, October 10 to 15. If expectations are realized, a full account of the conference will appear next month, thanks to Australian Corresponding Editor R. A. Bottomley.

Wick:

(Continued from page 241)

rated from the other flavor components.

The method which affords identification of a minimum quantity of an unknown is mass spectrometry. Samples amounting to 1 micromole, or approximately 0.05 to 0.3 mg., may be identified if they possess a vapor pressure of 0.02 mm. at the inlet temperature of the instrument. It is possible to obtain complete resolution at mass 300, or, in other words, to differentiate between masses of 300 and 301. The fact, however, that mass spectrometers having such capabilities are very expensive means that this method is not available in many laboratories.

Infrared spectrometry allows compounds to be identified in microgram quantities or in fractions of microliters.

Identification is often carried out by trapping the pure, separated flavor components in derivatizing reagents such as 2,4-dinitrophenylhydrazine, and examining the resulting product by its ultraviolet spectrum, its R_f value in paper chromatography, or by its physical properties (melting point, etc.). The examination of physical properties often requires a prohibitively large amount of unknown compound, particularly for all but the major components of a flavor extract.

The procedure followed in practice is to use as many methods as possible in the hope of achieving rigorous identification.

Recombining Components

The ability to recombine the known components of a natural flavor into a mixture which exhibits the natural flavor is, of course, the ultimate goal of a flavor chemist. As mentioned before, this goal has rarely, if ever, been completely achieved. It has, however, been possible to obtain definite knowledge of many of the major components of flavors and thereby to understand a large proportion of a flavor.

A Concluding Word

Very great advances have been made in this fascinating field. With patient, painstaking application of the methods outlined here, as well as of many others, great advances will be made in the future.

Literature Cited

1. Wiseblatt, L., and Kohn, F. E. *Cereal Chem. 37:* 55 (1960).

Flour Report:

(Continued from page 248)

Continued effort will be required before all pertinent factors can be adequately measured and expressed. There is also the need for development of specifications pertinent to other types of flour such as cake, cookie, and cracker flours. Undoubtedly, the American Association of Cereal Chemists will demonstrate leadership in these areas in the future.

Literature Cited

1. Cathcart, W. H. *Trans. Am. Assoc. Cereal Chemists 11:* 34–48 (1953).
2. Clark, R. J. *Trans. Am. Assoc. Cereal Chemists 11:* 68–77 (1953).
3. Garnatz, G. *Trans. Am. Assoc. Cereal Chemists 10:* 1–11 (1952).
4. Sullivan, Betty. *Trans. Am. Assoc. Cereal Chemists 11:* 77–88 (1953).
5. Whinery, J. S. *Trans. Am. Assoc. Cereal Chemists 11:* 49–67 (1953).

the President's Corner

news of the association

This is the time of year when many of us have an opportunity to begin anew. We are home from vacations; the young people are back in schools or universities. Our work assumes a new significance. We re-evaluate our programs and map new ones, for unless we carefully plan our activities, we will find much wasted effort.

Within your Association, too, plans are being made and put into effect. Beginning September 1, a drive was launched to bring in new members. Lyle Carmony, chairman of the Membership Recruitment Committee, has initiated an ambitious program. Its success is assured if each of you will help by bringing in one, two, or more members. Write to Mr. Carmony or to Raymond Tarleton for brochures and application blanks. As an extra incentive, those who join after September 1, 1960, will have free membership for the remainder of 1960 and will begin receiving Association publications immediately. The dues they pay will be for 1961, with a membership certificate suitable for framing available to each.

In my travels about, I have been impressed with the extensive plans being made by our more successful, growing local sections. On the other hand, in some sections planning for future meetings seems somewhat haphazard, growth and vigor are lacking, and attendance is declining. This is not a healthy kind of situation and I hope wherever it exists it will soon be corrected. In doing services for their members, local sections promote the growth and prosperity of the national organization as well. What are you doing to assist your professional society?

Your Board of Directors has been aware for sometime that the present membership structure excludes laboratory technicians, who could benefit through professional contact and educational opportunities offered by your association. A committee headed by D. B. Pratt, Jr., is studying this problem and will make recommendations to the Board. Please write Mr. Pratt and give him the assistance of your thoughts on the matter.

I wonder how many know that they may continue as Association members after retirement without payment of dues. Those reaching or approaching retirement need only to write Raymond Tarleton indicating their status.

JOHN A. JOHNSON

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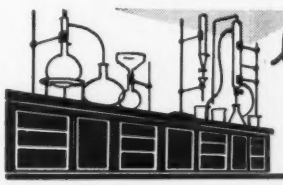


laboratory HELPS and GADGETS

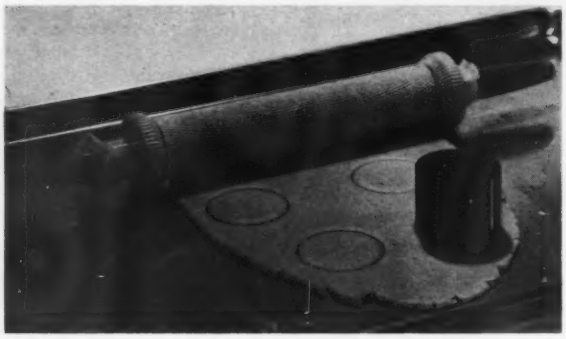
TECHNIQUE FOR OBTAINING UNIFORM DOUGH THICKNESS

The ability to secure reliable baking test results involving bread, biscuit, piecrust and cookie work lies to a considerable extent in the control of batter or dough thickness at make-up operations. If layers of finished dough prepared for baking are not uniform in thickness, baking response can not be accurately interpreted and all of the skill in controlling the weighing, mixing and, where utilized, fermentation conditions, is largely lost.

In *Cereal Laboratory Methods* (6th ed.), various methods are prescribed for regulating dough thickness. Mechanical devices, of course, have built-in adjustments, but in hand-baking operations the rolling pin, with gage strips or templates, is widely used. For example, our official baking tests for cookie flour (11.4, p. 61-62), biscuit work (11.1, p. 46), pie flours (11.5, p. 63) and "pup" loaves for bread flours (11.2b, p. 52) all prescribe either metal or wooden gages or tracks as the case might be, to be used in conjunction with a rolling pin. Proper dough thickness is then obtained by placing the dough between the gages and rolling the pin back and forth over

the dough until the pin itself rides on the gages, thus halting further reduction in dough thickness. Cutting, panning, fermentation if need be and baking, of course, follow.

The storage, care, and availability of separate gage strips is a problem at times. In our own laboratories we have found it possible to make the rolling pin do its own gaging. This can be accomplished by turning down the rolling surface, except at the edges, on a lathe. The turned down section is just as deep as the desired dough thickness. The modified rolling



pin, automatically riding on its original edges (see photo) eliminates the need for gages or strips, and rolls the dough pieces to the correct thickness.

F. R. SCHWAIN

AACC LOCAL SECTIONS

New York Section will hold its first fall meeting on Tuesday evening, October 11, at The Brass Rail. Robert H. Cotton, director of research for Continental Baking Co., Rye, N.Y., will address the Section on "Current developments in European cereal research." Information gleaned on his tour of England and the Continent in September will be summarized in his talk on laboratory methods and facilities there.

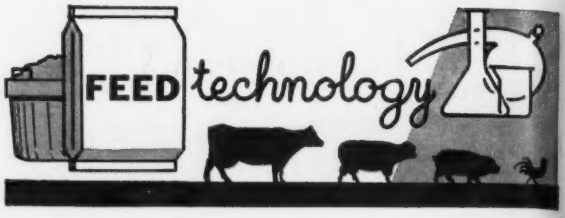
• • • •

Northern California Section's annual picnic was another of a series of popular and successful ones, held at Old Church Picnic Ground at Redwood Canyon on September 10. The aroma of broiling steaks and brewing coffee, mingled with the scent of fresh air and redwoods, makes a prescription that never fails for a wonderful time, and needs no elaboration.

• • • •

Pacific Northwest Section has appointed its committee chairmen for 1960–61: Membership, Fred Barrett; Special Awards, Don Colpitts; Commercial Scale, Martin Wise; Crop Survey, E. P. Walker; PNW Grain Storage Sanitation, Harold Blain; Advisory Committee to PNW Crop Improvement Association and Wheat Quality Laboratory, Otho Skaer, with Don Colpitts and William L. Haley; PNW representative to Western Wheat Quality Laboratory, Martin Wise; Directors of PNW Crop Improvement Association, Don Colpitts and William L. Haley.

Commercial-scale milling of the "Shorty variety" was expected to begin at Centennial Mills, Inc., Wenatchee, in early September.



NEWS AND ANNOUNCEMENTS

Pneumatic Conveying. Feed men interested in the fundamentals of this subject are directed to a Bulletin of the Association of Operative Millers, dated October 1959, authored by Jack Kice. This discusses theory, comparisons of negative and positive pressure systems, and related equipment. For copies, contact D. S. Eber, Executive Vice President, AOM, 639 Board of Trade Bldg., Kansas City 5, Mo.

Grinding Theory. A recent German publication on this subject was called to your departmental editor's attention by Harry Pfost, Department of Flour and Feed Milling, Kansas State University. This is undoubtedly one of the most complete discussions known on this important subject. The author is H. Rumpf of the Institut für Mechanische Verfahrenstechnik an der Technischen Hochschule, Karlsruhe. The paper appeared in Chemie-Ing. -Tech. 31, Jahrg. 1959, No. 5, p. 323. Numerous charts, graphs, and references are included. Here is a chance to "dust off" your technical German! Lacking this, you might ask to see the English translation, which Dr. Pfost prepared, the next time you are in Manhattan, Kansas.

Feed Analysis. The last issue of the Journal of the Association of Official Agricultural Chemists (May 1960) contained many of the papers of interest to feed chemists which were presented last October in Washington. Details on oleandomycin and Hygromycin B are covered. Numerous drug assays are presented, including those for piperazene, glycarbylamide, Zoalene, reserpine, nithiazide, Trithiadol, and furazolidone. Changes in official status of these and other drug assays are given. In addition to drugs, papers are presented on chlorinated solvents for crude fat in feeds, molasses mixtures, protein digestibility, gossypol, Santoquin, crude fiber, and calcium by flame photometer. These should be at the top of your reading list.

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BOOK reviews

Conditioning Wheat for Milling. A Survey of the Literature (October 1958), by Dorothy Bradbury, J. E. Hubbard, Majel M. MacMasters, and F. R. Senti, Northern Utilization Research and Development Division, Agricultural Research Service, U.S. Department of Agriculture, Peoria, Illinois. Reviewed by Technical Committee, AOM.

The authors deserve great praise for this extensive literature review on wheat conditioning. For the practical miller and milling engineer it brings together in convenient form detailed summaries of a wide variety of conditioning procedures—both successful and unsuccessful. The results cited will permit the more intelligent application of conditioning operations in specific mill situations. For those engaged in theoretical and applied milling research the data and summaries provide the background for developing an adequate research program on conditioning. The survey clearly shows a need for definitive data showing the degree to which conditioning procedures can contribute to greater economy of milling operations, increased yields of flour, and enhanced flour quality.

The survey is divided into three parts. Part I is a summary of data on conditioning; Part II concerns data on subjects related to conditioning, and Part III contains the bibliography.

Part I includes sections on definitions of terms and on cold, warm, and hot conditioning, with brief summaries. It is apparent that conditioning is far from a scientifically developed process. The literature contains many contradictions and leads to no satisfactory answer as to what are the conditions for moisture, temperature, or time for best milling results. Perhaps this situation is not surprising, because of the complexities involved in treating a biologically active and widely variable material such as wheat for processing, using different types of equipment, in different climates where the objectives and incentives of milling vary. Also, having the literature on conditioning methods available for review brings into focus in a striking manner the lack of complete, thorough, and highly competent scientific experimental comparisons of conditioning methods. Too much of the work reported represents opinions not clearly supported by data, and often the data provided were not obtained under controlled conditions.

Hot conditioning appears to be recommended principally where alteration in gluten properties is sought. The literature is confusing on what constitutes hot conditioning or what milling benefits to expect from it. Steam conditioning is a common procedure for the application of heat, although the literature contains reports on the use of ultrasonic and high-frequency waves, infrared rays, and a condenser system as methods for heating wheat during conditioning. The review contains many references to the vacuum drying of wheat after conditioning.

Part II is presented under three subheads: Hygroscopicity of wheat, Absorption and transmission of heat by wheat, and Entrance of water into the wheat kernel. These subjects have been covered generally by rather good experimental work which has appeared in commonly available scientific journals. The review provides an excellent opportunity for those interested to read pertinent literature without devoting time to a reference search. Unfortunately, the literature on these subjects is usually not directly related to wheat conditioning. Further research will need to develop the necessary relationships between the subject of conditioning and the scientifically practical application of conditioning to milling. In the meantime, those skilled in the art might recognize some degree of correlation with their milling and baking quality objectives and try exploratory installations and studies in milling production.

Part III with 666 literature references, is a most valuable and helpful contribution to milling technology. Most of the references cover articles published in the English and German languages during the past 40 years. Some in French, Spanish, Portuguese, Hungarian, and Russian are included.

While it would have been more helpful had the literature review led to a clarification of the differences of opinion that prevail on the subject of conditioning, nevertheless this situation is in no sense the fault of the authors, who have done excellently with the complex and difficult assignment. The milling industry has been thus handed a challenge to support collectively the type of research which will provide, for the benefit of all, factual information for the many twilight zones of knowledge of conditioning that exist at present.

Considering the many different methods used besides the many different types of raw material treated under different atmospheric conditions, it is not surprising that so many different answers and so many contradictions have been observed, and that no final answer has been established by this review. Scientists cannot spend the effort to test every variation of these factors and all combinations. It will always be up to the miller to interpret general conclusions in terms of his particular wheat-weather-product setup.

To the operative miller the sur-

vey gives a good cross-sectional picture of every method tried. It should be of help to the man who is used to the stepwise cold tempering method but who, on account of the space problem, is searching for other means of tempering, such as a combination of cold and hot or direct steaming. It should help the chemist and miller to make decisions and should save both a lot of grief and enable them to avoid repeating some of the mistakes other people have made and recognized.

Copies can be obtained by addressing a request to Wheat Conditioning Publication, Northern Utilization Research and Development Division, 1815 North University, Peoria, Illinois.

The superintendent of Documents, U. S. Government Printing Office, Washington, D. C. also has copies available for sale. The expected price is $1.00 per copy.

Synthesis and Organization in the Bacterial Cell, by E. F. Gale. CIBA Lectures in Microbial Chemistry. John Wiley & Sons, Inc., New York, 1959. Price $3.50. Reviewed by MILLARD F. GUNDERSON, Campbell Soup Co., Camden 1, N. J.

The book is divided into three sections: Structure and organization in the bacterial cell, Amino acid incorporation, and Nucleic acid and protein synthesis. Dr. Gale begins the book with a brief section on structure of the bacterial cell, including historical development of techniques for examining cell structure. Electron photomicrographs, composition (chemical), osmotic pressure, and enzyme digestion are used as tools in structure studies. Action of antibiotics is related to formation of various cell components. Certain antibiotics act by bringing about disorganization of the cell membrane. The author points out that surface structures are probably the sites of action of selective and differential agents. The organization of the protoplasm of bacteria is less complex than that of the multicellular organisms, and the distribution of enzyme activities among the membrane, granules, and soluble proteins may be different from those now accepted for mammalian cells.

Amino acid fixation has been found to include other substances than true or complete proteins. Amino acids can be fixed by soluble ribonucleic acid. Protein synthesis is suggested as occurring in the cell-wall membrane and not in the ribonucleic protein granules. There is an extensive section on amino acid incorporation in protein synthesis.

The third section deals with nucleic acid and protein synthesis. Protein synthesis can be divorced from RNA synthesis in spite of common amino acid requirements. A cyclic scheme is proposed for the formation of proteins by integration of amino acyl residues on a preformed RNA template and the formation of ribonucleo proteins by integration of amino acyl nucleotide structures mediated by DNA. The author points out that the difficulty of studying synthetic reactions with purified enzymes and in dealing with complex macromolecules is that catabolic systems can bring about polymerization reactions under unphysiological conditions *in vitro*.

The book is short, complex and jammed with complex data which require some advanced knowledge for understanding. A good book for researchers and advanced students. The author has done an excellent job of relating structure with function.

Fluidization, by Max Leva, Consulting Chemical Engineer; McGraw-Hill Chemical Engineering Series, 336 pp., 184 illust. McGraw-Hill, New York, 1959. Price, $11.50.

This book presents, in progressive fashion, all the major developments of a fundamental character pertaining to fluidization, which have originated since fluidization emerged as an important area of interest. It brings together in one volume descriptions of phenomena, experimental data, and working formulas that can be applied in studies of fluidization in many fields.

The volume deals with such subjects as the fluidized state, fixed bed and the onset of fluidization, dilute phase and moving solids, heat transfer, mass transfer, and solids and fluid mixing. The treatment is authoritative and embodies a number of features such as a critical presentation of numerous working correlations, explanation of fluidization phenomena as related to flow of fluids through fixed beds, discussion of the relatively new subject of spouting, and strong emphasis on foreign developments in this field. In addition to being a source book and reference, the volume provides the tools for applying fluidization to problems of greatly diversified character.

The author is a consulting chemical engineer and is responsible for many of the developments in this field. Further details available from McGraw-Hill Book Information Service, 327 W. 41st St., New York 36, N. Y.

Protecting Crops and Consumers; the FDA's Pesticide Control Program. U.S. Dept. of Health, Education, and Welfare. FDA Leaflet No. 6, Oct. 1958.

Insecticide Recommendations of the Entomology Research Division for the Control of Insects Attacking Crops and Livestock, 1960 Season. Agriculture Handbook No. 120, Agr. Research Service; revised March 1960. Price, 65 cents.

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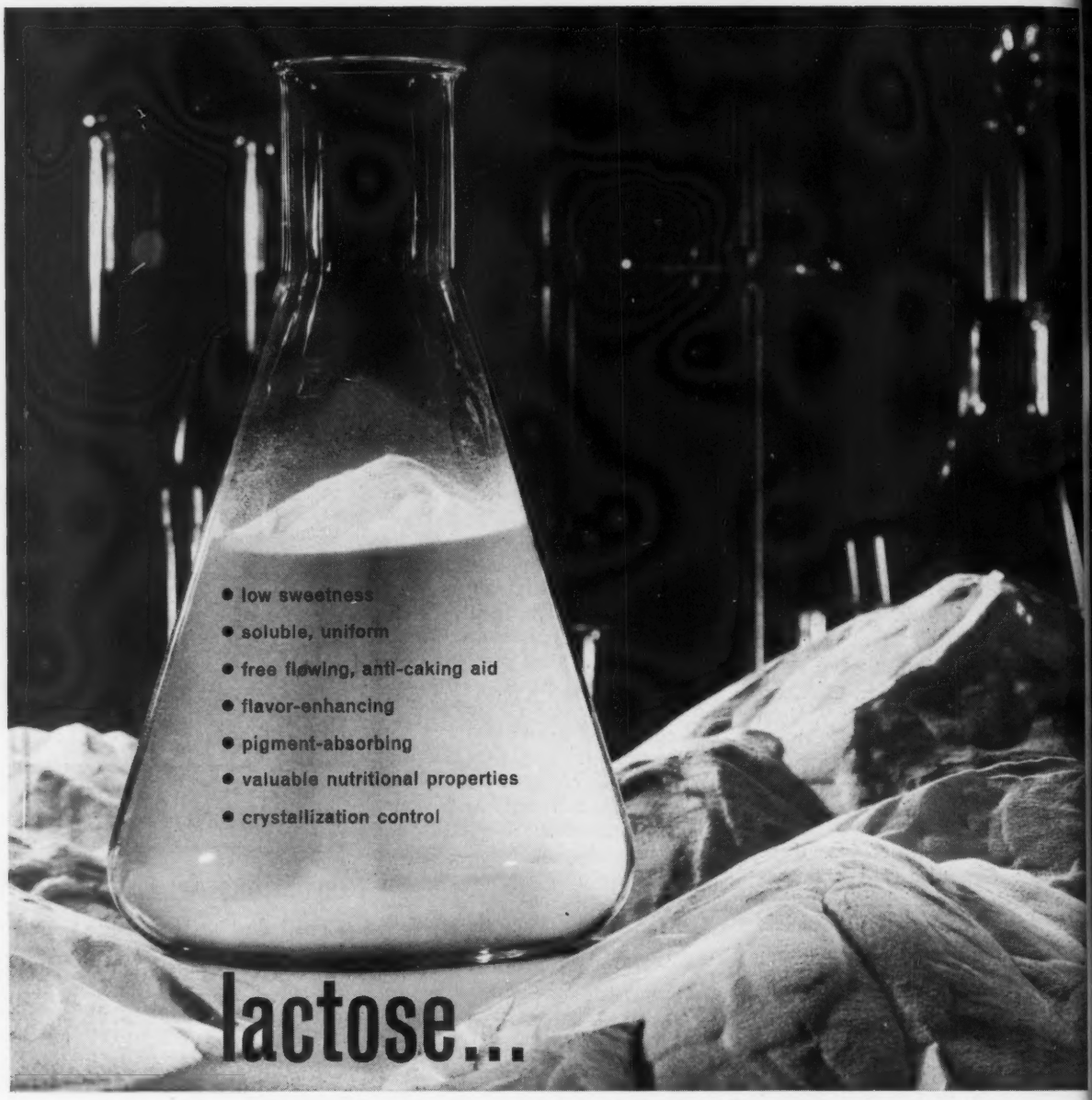

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